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RELATION OF THE CEREBRUM TO THE CEREBELLUM

II. CEREBELLAR TREMOR IN THE MONKEY AND ITS ABSENCE AFTER REMOVAL OF THE PRINCIPAL EXCITABLE AREAS OF THE CEREBRAL CORTEX (AREAS 4 AND 6a, UPPER PART)

III. ACCENTUATION OF CEREBELLAR TREMOR FOLLOWING LESIONS OF THE PREMOTOR AREA (AREA 6a, UPPER PART) †

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In the first paper of this series Fulton, Liddell and Rioch [1] demonstrated in the cat that the cerebral hemispheres are responsible for the genesis of cerebellar tremor. They found that after decerebellation the tremor appeared only when the voluntary movements became reestab-

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1. Fulton, J. F.; Liddell, E. G. T., and Rioch. D. McK.: Relation of the Cerebrum to the Cerebellum: I. Cerebellar Tremor in the Cat and Its Absence After Removal of the Cerebral Hemispheres, Arch. Neurol. & Psychiat. **28**:542 (Sept.) 1932. The delay in the appearance of the second paper of this series arose from the fact that the tremor of decerebellate monkeys, which had been studied with Drs. E. G. T. Liddell and Rioch in 1929-1930 failed to disappear when the excitable area of the cortex (i. e., as defined under barbituric acid anesthesia, thus including area 4 and a part of area 6aα) was removed. Attention was then given to the functions of area 6a, and it did not seem wise to pursue the relation between the cortex and the cerebellum further until the relation of area 6a to cortically integrated movements had been more thoroughly worked out. It is now evident that voluntary movements can be integrated in all parts of area 6 after area 4 has been destroyed (Fulton, J. F., and Kennard, Margaret A.: A Study of Flaccid and Spastic Paralyses Produced by Lesions of the Cerebral Cortex in Primates, A. Research Nerv. & Ment. Dis., Proc. **13**:158, 1932). The likelihood of an intimate relation between area 6 (Bieber, I., and Fulton, J. F.: The Relation of Forced Grasping and Groping to the Righting Reflexes, Am. J. Physiol. **105**:7, 1933) and the cerebellum thus became apparent, and the problem has therefore been taken up afresh.

lished and that removal of the cerebral hemispheres subsequent to decerebellation abolished tremor in the extremities opposite to the cerebral lesion; marked extensor rigidity also came on immediately after the cortical ablation. Vigorous reflex movements could still be evoked, but these movements were unaccompanied by cerebellar tremor. On the basis of their results and of the observations of Munk,[2] of Dusser de Barenne [3] and of Walshe,[4] who showed in man that cerebellar tremor is present only in voluntary movements, it was concluded that the nervous mechanism involved in the phenomenon of cerebellar tremor includes some part of the cerebral hemispheres. The present paper will offer evidence of a more definite localization of the regions responsible for cerebellar tremor in the decerebellate animal and in the animal in which the cerebellar peduncles have been sectioned.

That destruction of certain parts of the frontal lobe accentuates the signs of a previous cerebellar lesion is known both experimentally and clinically. Thus Luciani [5] noted that "as soon as the so-called motor zone is destroyed on one or both sides the animal (dog) with half a cerebellum loses for a long time, or forever, the newly acquired capability of holding itself upright and walking without falling toward the affected side." Demole [6] collected cases of congenital lesion of the cerebellum in which there were no symptoms until a later cortical lesion produced cerebellar signs.

Similarly well known in clinical medicine is the finding of cerebellar signs in cases of lesion of the cerebrum, especially in the frontal lobes. Bruns [7] first described ataxia in association with lesions of the frontal lobe, and Delmas-Marsalet,[8] after a thorough study of cortical lesions in the dog, concluded that there exists a "prefrontal" (just anterior to the sigmoid gyrus) syndrome of disequilibrium composed of the following elements: crossed hypotonia and ataxia, static ataxia in certain positions and a tendency to turn toward the side of the lesion. There was

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2. Munk, H.: Ueber die Funktionen von Hirn und Rückenmark, Berlin, A. Hirschwald, 1909.

3. Dusser de Barenne, J. G.: Die Funktionen des Kleinhirns: Physiologie und allgemeine Pathologie, in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1923, vol. 1.

4. Walshe, F. M. R.: The Significance of the Voluntary Element in the Genesis of Cerebellar Ataxy, Brain **50**:377, 1927.

5. Luciani, L.: Muscular and Nervous Systems, in Human Physiology, translated by Frances A. Welby, London, Macmillan & Co., 1915, vol. 3, p. 441.

6. Demole, V.: Structure et connexions des noyaux dentelés du cervelet, Schweiz. Arch. f. Neurol. u. Psychiat. **20**:271, 1927.

7. Bruns, L.: Ueber Störungen des Gleichgewichtes bei Stirnhirntumoren, Deutsche med. Wchnschr. **18**:138, 1892.

8. Delmas-Marsalet, P.: Études sur le lobe frontal et les voies centrales de l'équilibre, Rev. neurol. **2**:617, 1932.

no spontaneous nystagmus, and the postrotatory nystagmus reaction was the same regardless of the direction of rotation. Later clinical reviews on the subject of cerebellar signs in cases of lesion of the frontal lobe can be found in the articles by Claude and Lhermitte,[9] Vincent,[10] Grant,[11] Hare [12] and Frazier.[13]

Physiologic evidence is now given that in monkeys the premotor area (area 6a,[14] upper part; fig. 3) of the cortex is the part of the frontal lobe most concerned in compensation for cerebellar deficit and on a priori grounds, therefore, the region of the cortex in which injury is most likely to produce an exaggeration of cerebellar signs.

METHODS

Animals.—Sixteen animals were used in these experiments for long term observations: two baboons (Papio papio) and fourteen monkeys (Macaca mulatta). In some experiments decerebellation or hemidecerebellation was carried out before and in others after cortical extirpation. In some also a cerebellar syndrome was induced by section of the cerebellar peduncles. This is a relatively simple procedure and gives rise to marked cerebellar signs with less danger to the animals than is involved in removing the cerebellum. There have been no operative fatalities following peduncular section (six instances), and the animals were able to take nourishment and be active within from three to ten hours after the close of the operation. Four macaques survived complete decerebellation for periods ranging from six to ten months.

Procedures.—A description of the special surgical procedures employed in making cerebellar extirpations in monkeys will be given in an appendix.

Analysis.—Analysis of the cerebellar deficit has been made chiefly through unaided clinical observations of the tremors and motor disabilities: previous training has not been utilized as a means of analysis, but slow motion cinematographs were taken in some of the earlier experiments to assist in following the ataxic movements.

Terminology.—Since clinical methods of examination have been employed, we propose to use clinical terms in describing the results obtained. "Cerebellar ataxia"

9. Claude, H., and Lhermitte, J.: Les paraplégies cérébello-spasmodique et ataxo-cérébello-spasmodique consécutive aux lésions bilatérales des lobules paracentraux par projectiles de guerre, Bull. et mém. Soc. méd. d. hôp. de Paris **40**:796 (May) 1916.

10. Vincent, C.: De quelques causes d'erreur dans le diagnostic des syndromes d'hypertension intracranienne et dans celui de la localisation des tumeurs cérébrales, Rev. neurol. **19**:209, 1911.

11. Grant, F. C.: Cerebellar Symptoms Produced by Supratentorial Tumors, Arch. Neurol. & Psychiat. **20**:292 (Aug.) 1928.

12. Hare, C. C.: The Frequency and Significance of Cerebellar Symptoms in Tumors of the Frontal Lobes, Bull. Neurol. Inst. New York **1**:532 (Nov.) 1931.

13. Frazier, C. H.: Tumors Involving the Frontal Lobe Alone: A Symptomatic Survey of One Hundred and Five Verified Cases, Arch. Neurol. & Psychiat., to be published.

14. Numerical designations of cortical areas are according to the Vogts' modification of Brodmann's map, as indicated in figure 3 (Vogt, C., and Vogt, O.: J. f. Psychol. u. Neurol. **25**:273, 1919).

will refer to the full syndrome of "tremor" (astasia), "dysmetria," "rebound," "adiadokokinesis," etc.[3] "Cerebellar ataxia" and "cerebellar asynergia" have been used interchangeably.

GENESIS OF TREMOR IN MONKEYS FOLLOWING COMPLETE DECEREBELLATION

Complete decerebellation in monkeys has been reported by Luciani,[15] Munk,[16] Thomas [17] and Rademaker,[18] and extensive subtotal removal, by Ferrier and Turner,[19] Russell [20] and Lewandowsky.[21] All observers have agreed as to the character of the resulting deficit, but the underlying basis of the symptomatology remains unexplained and no one of the previous observers has devoted attention in primates to the specific chronology of symptoms following decerebellation. The course differs considerably from that observed in the cat [1] and in the dog.[18]

Detailed observations of complete decerebellation have been made in four monkeys. Apart from slight variations in eye movements the observations were similar in all four cases. There was much less exaggeration of extensor posture than one observes in the cat, and the seizures of opisthotonos, though occasionally present, were weak and seldom associated with retraction of the head. Also the animals attempted at an earlier period to execute voluntary movements, and in consequence the trembling ataxia appeared in the extremities at a much earlier period, i. e., within one or two days.

The following protocol of an animal which was studied over a period of six months illustrates the chief features of the completely decerebellate monkey.

EXPERIMENT 1 (cerebellar series, no. 9).—*Complete removal of the cerebellum; tremor within forty-eight hours; ability to walk after eight weeks; persistent and extreme ataxia; death from tuberculosis six months later.*

The animal used was a fat male rhesus monkey, weighing exactly 3 Kg. It was timid and difficult to manage but very deft and quick in all movements.

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15. Luciani, L.: Il cervelletto: Nuovi studi di fisiologia normale e patologica, Florence, Successori Le Monnier, 1891.

16. Munk, H.: Ueber die Funktionen des Kleinhirns, Sitzungsb. d. k. preuss. Akad. d. Wissensch. **49**:443, 1906; **53**:294, 1908.

17. Thomas, André: La fonction cérébelleuse, Paris, O. Doin & fils, 1911. This article contains a good bibliography.

18. Rademaker, G. G. J.: Das Stehen, Berlin, Julius Springer, 1931.

19. Ferrier, D., and Turner, W. A.: A Record of Experiments Illustrative of the Symptomatology and Degenerations Following Lesions of the Cerebellum and Its Peduncles and Related Structures in Monkeys, Phil. Tr. Roy. Soc., s.B **185**:719, 1894.

20. Russell, J. S. R.: Experimental Researches into the Functions of the Cerebellum, Phil. Tr. Roy. Soc., s.B **185**:819, 1894.

21. Lewandowsky, M.: Ueber die Verrichtungen des Kleinhirns, Arch. f. Physiol. **27**:129, 1903.

Operation (Dec. 2, 1930).—With the animal anesthetized with dial, given intraperitoneally, the muscles of the neck were separated well down to the bulging posterior cistern; the cistern was opened and the occipital bone rongeured away well beyond the lateral sinuses on both sides. On insertion of a curved spatula into the fourth ventricle it was possible to see the aqueduct, and when the peduncles had been identified they were quickly cut through on both sides with a curved knife and the cerebellum was removed in several pieces, with slight hemorrhage.

Postoperative Notes.—Respiration became poor soon after the cerebellum was removed and became gasping and rather shallow during the closure. The respiration remained poor during the first twelve hours after operation. At 9:30 p. m. the animal opened its eyes and showed fairly marked rigidity of all four extremities. There were no spontaneous movements.

First Day, 9:30 a. m.: The animal was fairly well recovered from the anesthesia; there was no retraction of the head and no evidence of nystagmus. No voluntary movements were observed.

5:00 p. m.: Voluntary movements had increased during the day, and every movement was associated with the wildest incoordination, all motions going wide of their mark. The movement was sporadic and ill timed, but there was no evidence as yet of the rapid oscillating tremor of the decerebellate monkey.

Second Day, 9:00 a. m.: Resting tremor of the head was apparent, and the ataxic movements of the upper and lower extremities were less gross than on the day before. No flaccidity could be detected on passive movement of the extremities. The knee jerks were equal and normal. Occasional nystagmoid movements were seen to the left, but there was no sustained nystagmus.

Third Day: The animal had assumed a horizontal sprawling posture but could not yet feed itself. It swallowed readily, however, when milk was poured into its mouth. Resting tremor was not yet particularly prominent.

Fourth Day: Well marked resting tremor of the head was apparent. The animal was able to support itself on its elbow, and this diminished the resting tremor. When sudden movements were executed it overshot wildly and sometimes turned over and rolled to the side of the cage. It had not yet been able to assume an erect posture. When grasping for food it frequently missed it by a wide margin.

Feeding was accomplished by rolling food toward the mouth with its hands and pressing its teeth into the food when it had been thus placed in position (fig. 1). When its face was held over a bowl of milk it could drink for long periods without difficulty.

Fifth Day: Generalized tremor of all extremities was still increasing and becoming more rapid. The animal sprawled and was still unable to maintain itself vertically.

Sixth Day: Repeated attempts had been made to demonstrate responses suggestive of the positive supporting reaction of cats and dogs, but there appeared to be nothing in the monkey that corresponded to these reactions. Pinching the sole caused active flexion of the hallux with slight flexion of the toes, as in a normal monkey. Tremor was becoming more rapid, and overshooting had increased.

Tenth Day: The emotional reactions of the animal continued to be those of a normal monkey. It screamed and struggled—just as did the other animal in the cage when one entered to catch them. If an apple was offered it made wild attempts to grasp it, frequently overshooting the mark, but when placed in its hand the food was brought to the mouth effectively. It also attempted to grab food from other animals.

Thirteenth Day: For the first time since operation the animal was *able to support itself in an upright posture* by grasping the bars of the cage. The resting tremor at times was so severe that it bumped its head periodically against the bars.

Seventeenth Day: The animal could still support itself, now more successfully than at first. Eye movements were normal; there was certainly no nystagmus.

Twenty-Seventh Day: The animal assumed the upright posture constantly. The general picture of incoordination was unchanged, apart from greater facility in skilled movements. Food was brought directly to the mouth in the paw rather than being pushed toward it on the floor of the cage. The animal sometimes struck itself in the cheek when attempting to feed itself with its hand. It was still unable to walk without support.

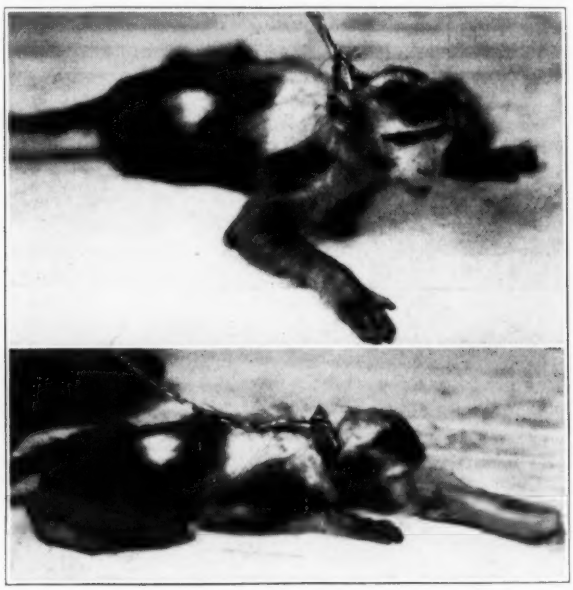

Fig. 1 (experiment 1).—A decerebellate monkey four days after operation, showing the sprawling posture and the method of approaching food.

Thirty-Third Day: The general picture was unaltered.

Fifty-Second Day: Careful study of the animal in feeding showed that there was certainly less tremor in the left hand than in right, suggesting that a small amount of functional tissue of the left hemisphere of the cerebellum might still remain. The difference in the two hands was slight but definite. The animal made feeble attempts to progress on all fours and to climb.

Sixty-Seventh Day: The animal was allowed to run free and dashed about the animal room, climbing up some cages and down others, exhibiting always the wildest ataxia but invariably attaining its objective. It was thought from this performance that its progress had been continuous since operation and that it was probably beginning to reach a state of equilibrium. The positive supporting reactions were again studied at some length, and the only response obtained on touch-

ing the bottom of the foot was a vigorous grasping reaction unassociated with contraction of the extensor muscles of the limbs.

One Hundred and Fortieth Day: The animal was still under observation. The neurologic condition was unchanged. No progress had been observed since the sixty-seventh day.

Subsequent Course.—During the fourth month after the operation a slight cough developed, and despite the fact that it ate voraciously the animal lost weight and became progressively worse, dying on June 11, six months after operation.

Autopsy.—Extensive pulmonary tuberculosis was present, and most of the abdominal viscera were involved by tuberculous lesions, but the brain was free. Before the brain was removed a dilute solution of formaldehyde U. S. P. (1:10) was injected into it. The cerebellum was found to have been completely removed on the right side, with a very small tag of cerebellar tissue, chiefly flocculus, remaining intact on the left (fig. 2). It was attached to the brain stem by a small strand of the superior cerebellar peduncle. The left, middle and inferior peduncles had been cut through. The vestibular nuclei were uninjured. The aqueduct of Sylvius was patent, and there was no evidence of hydrocephalus.

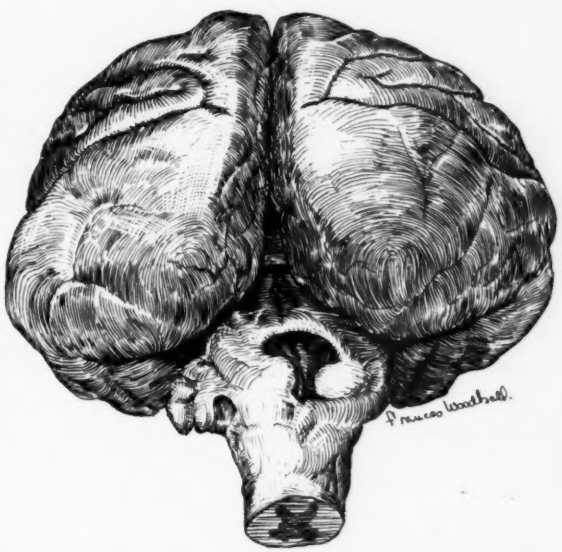

Fig. 2 (experiment 1).—A drawing of the dorsal surface of the brain, illustrating that the decerebellation had been virtually complete and showing a tag of cerebellar tissue which remained intact on the left side.

ABOLITION OF TREMOR

Ablation of Motor Area Causes Diminution but Not Abolition of Cerebellar Tremor.—Since the tremor caused by a cerebellar lesion occurs only when voluntary movements are present, it was natural to suspect that ablation of the motor area might possibly abolish the phenomenon. However, this has proved not to be the case. If some

time after hemidecerebellation or unilateral severance of the cerebellar peduncles, a lesion is made in the contralateral motor area (sparing the representation of the head to facilitate postoperative care [fig. 3]), cerebellar tremor is transiently abolished in the affected extremities. For several days after the motor lesion the animal exhibits paresis of the contralateral extremities and uses its unaffected extremities for skilled movements. The affected extremities, first used as props, are thereafter employed rather awkwardly in climbing and walking. With gradual return of motor power the cerebellar signs, which were at first abolished by the motor lesion, become more evident, but they never reach their former intensity; however, if a lesion is subsequently made

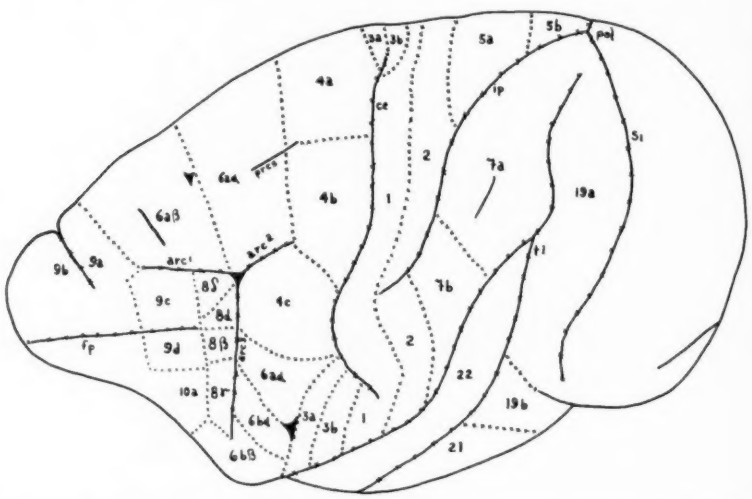

Fig. 3.—The Vogts' modification of Brodmann's cyto-architectural map of the cortex of the monkey (areas 11 and 12 are on the orbital surface of the frontal lobe). The motor representation of the leg is shown in 4a, that of the arm in 4b and that of the face in 4c. Area 6aα (upper part) and 6aβ together constitute the premotor area.

in the opposite motor area, the originally hemiparetic extremities are then used and cerebellar signs become more prominent. The following experiment illustrates these points:

EXPERIMENT 2 (cerebellar series, no. 5).—*Successive removal of the right cerebellar hemisphere, left motor arm area and right motor arm area at intervals of one month; cerebellar signs apparently abolished in the right arm after the second operation and restored after the third operation.*

The subject of this experiment was a sexually mature male rhesus monkey, weighing 4.2 Kg.

First Operation (Nov. 14, 1930).—Complete removal of right cerebellar hemisphere. With the animal under intraperitoneal dial anesthesia (2 cc. per kilogram) the cerebellum was exposed by the posterior approach. The right hemisphere was

separated from the vermis and removed in one piece. The flocculus was subsequently removed piecemeal. The roof of the fourth ventricle was not penetrated.

Postoperative Course.—First Day: The animal made a prompt recovery but during the day showed evidence of dizziness and nystagmus (slow component to the right) and of flaccidity on the right side.

Second Day: The animal walked cautiously on a broad base, with the right extremities abducted far from the midline. A coarse tremor and overshooting of the mark were observed during voluntary movements of the right upper extremity. Rolling movements of the entire body were occasionally seen.

Third Day: The head was tilted to the left, and a slight rotation of the head pointed the chin toward the right shoulder. The voluntary tremor and dysmetria of the right extremities were markedly increased; the bars of the cage were firmly grasped for support. Walking was possible, on a broad base. Passively manipulating the extremities revealed very little difference in resistance between the two sides.

Fifth Day: The tilted head, ataxia and broad-based gait of the right extremities remained about the same.

Eighth Day: Great incoordination of the right extremities continued. The animal made many inaccurate jumps, occasionally falling on its back. The resting posture of the hind limbs, was about alike; there was more spontaneous activity in the left. The tendon reflexes were equal, and there was no difference in the resting posture of the extremities.

Fourteenth Day: There had been gradual improvement in the neurologic status during the previous six days. The head was tilted somewhat to the left. In ordinary progressive movements the animal showed much less disability than formerly. It ran and jumped without missing its mark and without bumping into objects. There was still rather marked ataxia in the right upper extremity, seldom seen, however, except when the animal was attempting to reach for or handle some object.

Twenty-Sixth Day: The head was still tilted toward the left. The animal ran about the room deftly; the base was rather broad, and in long jumps it sometimes fell to the left. During feeding and other movements which required postural activity, overshooting was definite in the right upper extremity but tremor was only slight.

Second Operation (Dec. 10, 1930).—Identification of left motor arm area by monopolar stimulation; extirpation. With the animal under intraperitoneal dial anesthesia (1.5 cc. per kilogram), the left motor area (area 4) was exposed, and the arm area was outlined and extirpated with the electric loop. Subsequent to the extirpation, monopolar stimulation evoked responses of the face within 1 mm. of the edge of the lesion, but no responses of the arm were obtained anywhere along the margin of the lesion.

Postoperative Course.—Second Day: The animal was sitting up in its cage looking a little dazed and still sufficiently affected by the anesthetic to allow intimate handling. It fed itself with its left upper extremity. The right arm hung pendant by the side and occasionally exhibited slow associated movement when carrying out voluntary activity with the left hand. On passive manipulation the right upper extremity was not entirely flaccid, as when only the arm area was removed.

Third Day: No attempt was made to use the right arm except as a prop. Occasionally when turning quickly to the right the animal lost its balance and the right hand was placed against the floor, usually resting on the dorsum, giving slight support, but it could not be used for grasping; allowed to run loose in the

room, the animal jumped onto a bench and on losing its balance grasped vigorously with the left hand, but the right hand did not move. There was evidence of some motor impairment of the right leg; at times it tended to slip out laterally when at rest.

Fifth Day: The right arm still hung pendant, and there was almost no voluntary power at the wrist and fingers.

Tenth Day: The monoplegia continued profound; the right upper extremity tended to be held in a semiflexed posture. The motor impairment of the right lower limb remained unchanged.

Twenty-Seventh Day: The neurologic condition of the right upper extremity was practically unchanged. When food was placed in the right hand it was shifted to the left in order to bring it to the mouth. The right upper extremity was used during climbing only for passive support. The right lower extremity still showed some weakness, as the animal grasped much more effectively with the left foot.

Forty-Eighth Day: The right upper extremity was held in a somewhat hemiplegic attitude and was never used for feeding or delicate movements of any sort. It was employed clumsily in climbing and occasionally in walking.

Third Operation (Jan. 28, 1931).—Delineation of right motor arm area by monopolar stimulation; extirpation. With the animal under light anesthesia with pentobarbital sodium (intraperitoneal) the right motor area (area 4) was exposed, and the area which, when stimulated, caused movements of the shoulder, arm, elbow and wrist was outlined and extirpated.

Postoperative Course.—Immediately after the procedure, marked weakness of the left upper extremity was present and slight weakness of the left foot. The animal was active and occasionally fell toward the left.

First Day: The animal attempted to eat with the right hand, which showed marked ataxia. After a number of unsuccessful attempts at bringing the food to the mouth, it ate by picking the food from the floor with the mouth.

Second Day: The animal was considerably brighter. Objects were grasped awkwardly with the right hand. There was marked ataxia in all movements of the right upper extremity, which had not been apparent before the last operation. It supported itself with the left arm without using the fingers. The recent weakness of the left upper extremity caused the right to be used and thus served to demonstrate the ataxia.

Fourth Day: The animal was still unable to bring anything to the mouth, although frequent attempts were made, chiefly with the right hand. This member continued to show extreme tremor and dysmetria.

Fifth Day: The animal was beginning to grasp things with the left hand almost as effectively as with the right, and both extremities were used for climbing.

Sixth Day: The general condition had been satisfactory, but the animal received a scalp wound from another monkey; this was repaired.

Seventh Day: There were marked tremor of the right hand during voluntary motion and some recovery of motor power of the left upper extremity. The wound was draining freely.

Fourteenth Day: The discharge had ceased, and the wound was rapidly granulating. The neurologic status was unchanged.

Twenty-First Day: The wound was granulating satisfactorily. Marked weakness of the left upper extremity remained. The ataxia of the right upper extremity was so great and the animal had such difficulty in grasping for food that it usually preferred to put the face down to the plate to eat.

Fifty-Second Day: The scalp wound was completely closed and epitheliated. There was practically no difference in use between the legs; they moved with speed and accuracy. Marked weakness was still present in the left upper extremity, and ataxia and dysmetria remained evident in movements of the right.

Subsequent Course.—The neurologic picture remained practically unchanged until death. On the ninety-ninth day the animal was sluggish. It had gradually lost weight during the preceding two weeks. On the one hundredth day it became moribund and was killed with a small amount of ether.

Autopsy.—Formaldehyde was injected into the central nervous system through the left side of the heart, and the brain and spinal cord were removed and placed in formaldehyde. There was a large amount of pus between the posterior part of the recently healed incision, which penetrated the bone flap.

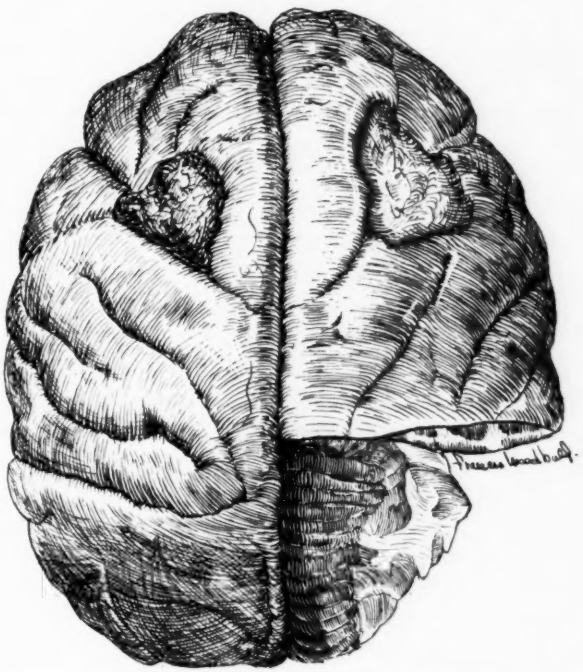

Fig. 4 (experiment 2).—A drawing of the dorsal surface of the brain, illustrating the craters which marked the extirpation of the motor arm areas (area 4 plus part of area 6) and the small portion of the anterior inferior surface of the right cerebellar hemisphere which remained intact. The right occipital lobe was removed to allow a view of the cerebellar region.

The lungs and abdominal viscera showed evidence of extensive miliary tuberculosis.

Right Cerebellar Hemisphere: The whole cortex of the right cerebellar hemisphere appeared to have been removed posteriorly (fig. 4). The vermis was intact and in good condition. The right flocculus was present and also a small amount of the anterior inferior surface of the right cerebellar hemisphere. The fourth ventricle was of essentially normal shape, with a patent aqueduct and no sign of obstruction. The right seventh and eighth nerves were intact.

Left Cerebral Hemisphere: The left cerebral hemisphere was in good condition, with the pia intact throughout except for the region of the arm area. The lesion was still well delineated, with fairly deep edges and a considerable amount of yellow gliosis. It appeared that the inferior posterior margin was less steep than one would have wished and failed to involve all the tissue facing the sulcus. The foot area was intact and in good condition.

Right Cerebral Hemisphere: The whole arm area was undoubtedly destroyed; the gliosis and fibrous tissue reaction involved some of the corresponding postcentral gyrus. The foot area was intact and of about the same consistency and size as that in the opposite hemisphere.

From the point of view of this experiment the extent of all three lesions was entirely satisfactory. The third lesion was slightly more extensive by virtue of the infection than had been originally intended.

There are five other instances in the series which closely parallel this. A motor lesion subsequent to a contralateral cerebellar lesion appears temporarily to abolish tremor. In an active animal, tremor and dysmetria begin to return in the contralateral extremities with the return of motor power, usually on from the tenth to the fourteenth day. The tremor of the extremities returns to a greater degree than does the swaying oscillation of the head and trunk, but it is not until a lesion is made in the remaining motor area that the cerebellar signs approach their original severity. In "motor area" animals there is thus a reduction in cerebellar signs, probably proportional to the impairment of voluntary movement.

An extremity that has lost its motor (area 4) and cerebellar innervation, regardless of the sequence of the lesions, is no longer able to perform finely coordinated movements of the hand, such as manipulating bits of food; the whole hand is used to grasp small objects, even though it is only moderately ataxic. The animal tends permanently to avoid using these extremities for skilled movement, but their disability may be readily demonstrated by restraining the opposite extremities. It is then apparent that the attempted skilled movements are curiously ineffective. The hand reaches toward an object fairly accurately and without much tremor, but hovers over it and seems incapable of grasping it. When, however, an object is placed in this affected hand, a very powerful, possibly involuntary, flexion of the fingers and withdrawal of the extremity occur.

Combined Ablations of Motor and Premotor Areas Causes Abolition of Cerebellar Tremor.—Attempts have been made to abolish the ataxia completely, and it has been found that this can be achieved only by extirpating all the excitable cortex of the cerebrum. This is illustrated by the following experiment:

EXPERIMENT 3 (cerebellar series, no. 27).—*Bilateral motor-premotor preparation with section of the right cerebellar peduncles; complete absence of tremor on the right side.*

The subject of this experiment was a mature male rhesus (Macaca mulatta) monkey, weighing 5.3 Kg. Three preliminary operations were performed.

First Operation (*Oct. 26, 1934*).—The right cerebellar peduncles were severed.

Second Operation (*Nov. 13, 1934*).—The left premotor area (area 6a, upper part) was removed.

Third Operation (*Jan. 22, 1935*).—The right motor and premotor areas (areas 4 and 6a, upper part) were removed.

Fourth Operation (*Feb. 5, 1935*).—The left motor area was removed.

Postoperative Course.—Four hours after the close of the final operation the animal was conscious but dazed. The right extremities were held rigidly extended. The left extremities were held flexed, but this flexion was easily broken by passive manipulation. The animal was able to move the left extremities weakly. There was a grasp reflex in the left hand but no reaction to stroking the soles of the feet.

First Day: The animal was lying on the floor of the cage, nearly helpless. The right limbs were in rigid extension, but one was able to break this rigidity with some effort. There was very slight movement in the left extremities. A marked grasp reflex was elicited from the left hand and foot (animal in right lateral horizontal position), while no response was obtained from the right hand and foot. No response was elicited to pinching either sole. Feeding had to be done by hand; the animal ate well. It had to be hand fed almost entirely for the rest of its life, although it was able to reach and eat food placed close to the face.

Second Day: The right upper extremity was now held up against the chest, with flexion in all the joints. It was not completely spastic; if one changed its position and then released it, it resumed the position of flexion rather rapidly and without tremor. The right lower extremity was held rigidly extended; one was able to break this rigidity by constantly opposing it; the joints then flexed, but on release the extremity returned to rigid extension. No active movements were observed in the right extremities up to this date. The left limbs were usually held in moderate flexion. The left extremity was occasionally moved. Grasp reflexes strong enough to suspend the animal were elicited from both hands. No response was obtained on stroking or pinching the soles of the feet. A short, sharp knee jerk was obtained on the left; the rigidity probably inhibited the right knee jerk. Rotating the head from side to side did not change the limb patterns.

Third Day: The animal resisted all passive movements by grasping the wires of the floor of the cage, a reflex grasp that was broken only with difficulty. The monkey lay on either side as placed; the right extremities were flexed and adducted. Stroking and pinching the feet elicited no reflex; squeezing the calves resulted in flexion of the toes. Passively moving the right lower extremity sent it into strong extensor spasm. Holding the monkey by the pelvis and the neck and allowing the feet to touch the wire floor caused them to grasp. The extremities crossed, owing to the strong adductor spasm, and stiff walking movements occurred. These were performed despite the great spasticity (especially in the right extremities), as though all the flexor and extensor muscles were contracting somewhat simultaneously. No ataxia was seen in these movements. The tail, as viewed from the rear, described strong clockwise circles.

Fourth Day: The right extremities remained flexed and adducted, regardless of the side on which the animal was placed. Manipulating either leg, both of which showed spasticity, sent them into gradually increasing extensor rigidity. Grasp reflexes were elicited from both hands and feet. Automatic movements of

the right extremities appeared spastic and without tremor. The tail described counter-clockwise circles (viewed from the rear). Righting reflexes were active.

Sixth Day: The left extremities were infrequently and weakly moved voluntarily. The right extremities continued their posture of flexion and adduction. The left lower extremity was also held in this position. Passively moving the right lower extremity sent it into gradually increasing extensor rigidity. This could occasionally be broken at the knee by using strong force. One was unable to produce this extensor rigidity from the left lower extremity. The spasticity was much less in the left extremities than in the right. Grasp reflexes were elicited from both hands. No plantar responses to stroking or pinching were present.

Seventh Day: The animal attempted righting with the head and neck when placed on its back. The voluntary motion present in the left extremities (upper more than the lower) was slightly increased. There was no voluntary motion in the right extremities. The right extremities continued to maintain their position of flexion and adduction, the upper more so than the lower. All extremities showed spasticity, which was more marked in those of the right side. The grasp reflex was elicited from all the extremities; it was strong in the hands and weak in the feet. The stimulus necessary to elicit the right knee jerk was less than that needed to elicit the left. The right knee jerk was very short and sharp; it responded immediately to the stimulus and relaxed just as quickly. Tapping the left patellar tendon elicited a series of clonic jerks; the response was somewhat slower than that of the right side. With the animal lying on its left side, a sharp dorsiflexion of either foot resulted in a short generalized tremor, which seemed to be an extensor thrust in all the extremities. The head rose from the floor; the foot from which the response was elicited was felt to thrust tremulously against the hand; the remaining extremities extended in short jerks. The tail moved spasmodically, and the animal vocalized. The response resembled a short generalized convulsion. This response could be continuously induced by sharply dorsiflexing either foot but could not be elicited if the time between stimuli was too short.

Eighth Day: The convulsion-like movements described could be elicited with the monkey lying on either side. When the animal was supported in the upright sitting position, these movements occurred spontaneously about every thirty seconds. Vocalization accompanied each series of movements; between the movements the animal looked about, groping with the left hand and attempting to grasp the wires of the side of the cage. The monkey preferred to lie on its left side and if placed on the right side struggled. There was loss of skin beneath the toes and fingers, probably due to the tremendously powerful grasp reflex, which kept the hands and feet fixed to the wires of the floor of the cage. Occasionally one observed short, automatic walking movements of the extremities. These were without tremor.

Ninth Day: The seizures were easily elicited with the animal lying on the right or the left side. When one passively flexed any of the points of an extremity and a position of moderate flexion was reached, clonic movements of the extremities occurred and tended to extend them. These movements occurred on elicitation of the grasp reflex from the left hand, this being the only place where one was able to elicit a grasp reflex on this day. When the monkey was supported on the feet, the toes strongly grasped the wires of the floor of the cage, and the lower extremities were rigidly extended. In this position one occasionally observed repeated automatic movements in the upper extremities. They were performed slowly and were of small amplitude and without tremor. All the extremities con-

tinued to show increased muscle "tone"; there was more resistance to passive movements of the left extremities than of the right.

Twelfth Day: With the animal in the left lateral horizontal position one could elicit a strong grasp from the left hand and right foot. The stroking of the feet and hands used in testing for this reflex initiated the convulsive extensor movements described in previous notes. Stroking the sole of the left foot did not result in grasping, however; it caused withdrawal and then generalized "clonic extension." Repeated automatic walking movements of the extremities were without tremor. The loss of skin beneath the left fingers and toes persisted, and these areas were mildly infected. The monkey took water and food greedily but required hand feeding.

Thirteenth Day: With the monkey on its back in a symmetrical position, the right extremities assumed an attitude of rigid extension, much more than the left extremities. When the animal lay on the left side, the right upper extremity was held flexed and adducted against the chest and the right lower extremity extended. "Reflex extensor convulsion" could be elicited by the flexion of any joint of any extremity but not by pain stimuli. The monkey had lost much weight and was not feeding well.

Fourteenth Day: With the animal lying symmetrically on its back, the right lower extremity was held rigidly extended. Manipulation produced a stronger extension. One's full force was required to flex the points of this extremity, and when they were released the extended position was assumed again. The left lower extremity was held flexed in all the joints; it resisted extension. Change in position of the animal did not alter the posture of the limb. The tail was rigidly extended when the animal was placed on either side. The right knee jerk was prevented by the rigid extension of the right lower extremity. Grasp reflexes were obtained from all plantar surfaces, except that of the right hand; they were reenforced by turning the animal so that the extremities to be tested were uppermost. With the animal in the right lateral horizontal position one occasionally obtained a generalized extensor thrusting on passively flexing a left lower extremity. It was possible to obtain the Magnus de Kleijn reflex on rotating the head toward the left or right, but it was obtained only with the monkey lying on the left side. In this position repeated automatic walking movements were made by all the extremities. These were carefully observed for tremor, but there was no trace of it.

Fifteenth Day: The animal had been failing for the past three days, and on this day for the first time it would not accept nourishment. Generalized extensor movements and the Magnus and de Kleijn reflex could not be elicited. The automatic walking movements of all the extremities were even more vigorous, and almost continuous. There was no trace of tremor in these movements.

Because of its poor condition, the animal was anesthetized and the extremities tested for contracture. The left achilles tendon was markedly contracted and fixed the foot at an angle of about 60 degrees. This contracture allowed for neither flexion nor adduction of the foot. There was some contracture about the right elbow. Flexion of the forearm was possible, but it could not be extended beyond 60 degrees.

Autopsy.—A liter of saline solution followed by a liter of a dilute solution of formaldehyde U. S. P. (1:10) was washed through the vascular system (into the left ventricle and out via the right ventricle), and an autopsy was immediately performed. There were pressure sores over the right hip, wrist and face, but they were not unduly infected. The thoracic and abdominal cavities and their

contents were normal. After eight days' fixation in solution of formaldehyde, the brain was examined. The motor (area 4) and premotor (area 6a, upper part) areas had been completely removed bilaterally, except for a very small strip of the lowermost portion of the hand representation of the right motor area. This probably explains why weak voluntary movements (feeding) were occasionally observed in the left hand. The lower, the middle and the inferior portion of the upper right cerebellar peduncle had been severed.

The cortical areas extirpated in the second, third and fourth operations were sectioned and stained by Nissl's method. Microscopic examination of all these sections proved that extirpations had been limited to the areas for which they had been intended. They all contained a small strip of white matter which underlay the cortical elements.

Several important facts emerge from this analysis of the unilateral cerebellar, bilateral motor-premotor monkey. In the first place the strong hyperextension elicited on passive flexion of any joint appears to be due to the same process of release as that encountered in decerebellate animals [1] other than the monkey. This also suggests that the resting posture of such a monkey may be interpreted as identical with that of decerebrate rigidity which occurs in its maximal form only when the influence of the cerebral cortex and the cerebellum (via the superior cerebellar peduncle) is removed. This indicates that in the monkey, as well as in the cat, both the cerebellum and the cerebral cortex inhibit the antigravity musculature (primarily extensor). The difference between the flexor-extensor picture in the front and that in the hind limbs of the monkey (as compared with the cat) is clearly due to the different uses to which these animals put their extremities.

Finally, the unilateral cerebellar, bilateral motor-premotor monkey executes certain spontaneous reflex movements which are rhythmic and resemble walking. These movements become more frequent and vigorous as time progresses, but they never exhibit cerebellar tremor.

ACCENTUATION OF CEREBELLAR TREMOR

Isolated Lesions of Premotor Area.—The premotor area of the monkey has a small corticospinal connection via the pyramidal tracts, but its major projection systems are extrapyramidal, i. e., to the substantia nigra and the red nucleus, and the premotor region also gives a major contribution to the frontopontocerebellar system.[22] The influence of removing the premotor area on a previously established cerebellar syndrome therefore invites attention. As already mentioned, Demole [6] found that lesions of the frontal lobe in man cause accentuation of cerebellar signs in cases of cerebellar atrophy; ablation of the motor

22. Levin, P. M.: The Efferent Fibers of the Frontal Lobe in the Monkey, Proc. Soc. Exper. Biol. & Med., to be published. Bailey, P.; Poljak, S., and Levin, P. M.: Tr. Am. Neurol. A., to be published.

area, in our experiments, however, led to a marked depression of cerebellar tremor. Lesions sharply restricted to the premotor area, on the other hand, caused a dramatic accentuation of previously established cerebellar signs. This observation is of great interest in itself; moreover, it substantiates the inference made on other grounds that the premotor and motor areas of the cortex are functionally, as well as microscopically, discrete. The following experiment may be cited as an example:

EXPERIMENT 4 (cerebellar series, no. 26).—*Section of the right cerebellar peduncles, followed in three weeks by extirpation of the left premotor area (area 6a, upper part); marked accentuation of cerebellar signs after the second operation.*

A sexually immature male rhesus monkey, weighing 2.2 Kg., in excellent physical condition, was the subject of this experiment.

First Operation (Sept. 26, 1934).—Section of right cerebellar peduncles. With the animal under intraperitoneal sodium amytal anesthesia (1.3 cc. per kilogram), the cerebellum was exposed by the posterior approach. The vermis was gently elevated, and the peduncles on the right were cut through with a hooked knife. The animal's respiration was not affected by the operation, and the loss of blood was insignificant.

Postoperative Course.—The monkey was completely conscious three hours after the operation. It was unable to stand, and when an erect posture was attempted it fell toward the right. It rolled clumsily about the cage until the side wall was reached, to which it clung. Then the erect sitting posture was again attempted; the animal pulled itself up from a right lateral horizontal position to about a 60 degree angle with the floor, but it never assumed the completely erect posture. This leaning position was maintained by clinging to the wires of the side of the cage with the left extremities. The head was inclined toward the right shoulder. Nystagmus (horizontal and vertical) was observed, regardless of the direction of gaze. Asynergia and tremor of the right extremities were obvious.

First Day: The animal was active. Marked oscillatory tremor of the head and tremor of the trunk were present. The trunk listed toward the right to about a 60 degree angle when sitting was attempted. The head remained tilted to the right. The monkey was able to move about the cage by holding with the left extremities. The usual progress forward could be described as of "corkscrew" type; the animal made a complete revolution around the longitudinal axis, rolling to the right when it attempted progression. Marked ataxia and overshooting were seen when the right extremities were used to gather food and in feeding.

Second Day: The monkey was able to maintain a sitting posture by clinging to the wires of the cage with the four extremities, but this support did not prevent a list toward the right. If it was not disturbed voluntary movement appeared to be restricted. The irregular oscillating tremor of the head was more marked than the tremor of the body. The tremor became violent when the animal was disturbed. Forward progress was still accomplished by the crawling, rolling motion described in the note immediately preceding. Climbing was attempted, the right extremities showing marked asynergia and dysmetria during the process. Nystagmus remained.

Third Day: Climbing was possible, but with marked right-sided asynergia. Rolling movements had disappeared; the head repeatedly nodded toward the right, bumping into the side of the cage. When undisturbed the animal sat in the rear

corner of the cage, holding on with the four extremities and seemingly restricting voluntary movement.

Fifth Day: The erect sitting posture was assumed with more assurance; equilibrium was still maintained in this position by holding the wires of the cage with the left extremities. The standing posture had not been assumed. The monkey would crawl after bits of food, but this brought out the marked tremor of the head, trunk and right extremities. On conveying food to the mouth with the right upper extremity, wide swinging oscillations occurred. The monkey obtained bits of food (banana) as it was carried by its mouth; the greater part of it, however, was plastered about the nose and eyes and both sides of the head. Nystagmus had disappeared.

Seventh Day: Standing was possible by holding onto the side of the cage with the left hand. The monkey walked in a semisitting position; the upper extremities were occasionally used as props. The oscillating tremor of the head and the wavering tremor of the trunk were not as violent. Asynergia of the right extremities remained obvious.

Thirteenth Day: Walking was on all fours, with the right extremities abducted to make a broad base.

Sixteenth Day: There had developed increasingly improved control of the right extremities. Despite the improvement the tremor and dysmetria were obvious. Oscillating tremor of the head and wavering tremor of the body were marked on volition. Walking on all fours on a broad base was possible, as was also climbing. When the animal was at rest, the right upper extremity was usually held adducted against the chest with all joints flexed, the hand dropping. This attitude had been observed since sitting had been attempted on the first postoperative day.

Twenty-First Day: The animal sat and stood erect. There was no tremor of the extremities when the animal was at rest. The animal had become increasingly agile since operation. It was able to negotiate long jumps outside the cage. The movements of the right extremities had become so quick that they were followed with difficulty. During voluntary movements one was able to observe an occasional oscillatory, side-to-side tremor of the head and a gross jerking of the trunk toward the right. When the right upper extremity was used for skilled movements, mild swinging ataxia was seen. These tremors were less than on previous occasions. The right extremities showed some tremor during climbing and walking; the animal veered slightly toward the right on forward progression. The neurologic picture had remained practically unchanged during the five days immediately preceding.

Second Operation (Oct. 18, 1934).—Extirpation of left premotor area (area 6a, upper part). The monkey weighed 2.3 Kg. Anesthesia was induced with sodium amytal (1.3 cc. per kilogram), intraperitoneally. A bone flap was turned down on the left side, and the left premotor area was outlined and excised. The procedure was uneventful, the animal remaining in excellent condition throughout.

Postoperative Course.—The animal was completely conscious three hours after the close of the operation. It was attempting to maintain a sitting posture, but there was a marked list to the right. There was repeated wobbling to the right, generally resulting in a sudden fall. The head sometimes oscillated against the floor when nodding toward the right. Despite this the monkey was able to eat. The forward progression movements were similar to those seen after the first operation, i.e., forced rolling ("corkscrew") toward the right. Five hours after operation the animal was even more active and continued to eat everything given to it. The trunk repeatedly listed toward the right when the animal attempted

a sitting position. If the right hand and fingers came in contact with the wire floor of the cage, this was grasped vigorously and the animal was unable to release the grasp.

First Day: The animal was found sitting in the rear corner of the cage holding onto the floor. The repeated movements of the trunk can best be described as "nystagmoid." The trunk slowly listed to the right, and when it made an angle of about 30 degrees with the floor the animal quickly jerked itself erect. This was repeated many times. The tremor and dysmetria of the right extremities were so great that the monkey ran headlong into the rear of the cage, reopening the anterior third of the incision.

Second Day: In the sitting position the right upper extremity hung at the side. The "nystagmoid listing" toward the right continued; correcting movements were more violent, and the marked overshooting of the entire trunk made the final position an overcorrected one, the animal momentarily assuming a semi-standing attitude, with the trunk inclining backward and toward the left. Forced rolling movements had abated; when frightened the animal leaped and grasped the wire roof of the cage. This position was ideal for eliciting the grasp reflex, and marked forced grasping was observed in the right hand, which (despite the very slight weakness in the right extremities) suspended the monkey by the right hand for from ten to twenty seconds after it released the left hand in an attempt to descend.

Fifth Day: The cerebellar signs remained markedly accentuated. The right extremities showed the wildest tremor and overshooting, so much so that occasionally they landed in the water pan as the animal walked about the cage. The gait was broad-based, with veering toward the right, and checking movements were very poor because the monkey repeatedly ran up against the sides of the cage, usually injuring its head. All cerebellar signs were increased by fright. The animal did not use the right extremities for skilled acts. There was no resting tremor. The scalp opening was clean and granulating without infection.

Seventh Day: The cerebellar signs remained unchanged. The repeated listing of the trunk toward the right and the violent correcting movements were striking. They were almost continuously present when the animal was in the sitting position.

Fifteenth Day: Resting tremor had never been observed. There was no change in the status of the cerebellar signs. This monkey was unable to relax well during handling; forced grasping disappeared on the tenth day.

Twenty-Sixth Day: The broad-based gait, with veering toward the right and listing toward the right when sitting, remained obvious. There was no resting tremor. The monkey had not used the right hand for skilled movements (the handling of small objects, feeding, etc.) since the second operation. Therefore a cuff which enclosed the entire left hand, forearm and upper part of the arm was applied, which compelled the monkey to depend entirely on the right upper extremity for feeding. This annoyed it somewhat, but it soon settled down to try feeding. When attempts were made to pick up food with the right upper extremity, asynergia and dysmetria were tremendous and actually prevented the monkey from obtaining anything. After vain attempts for about ten minutes, and finding the tremor ever increasing on intention, the animal became somewhat disturbed and fell to the right, rolling over on several occasions. The rolling was usually checked only by an impact with the side of the cage. The cuff was removed after twenty minutes; the cerebellar signs remained accentuated by the experience.

Thirty-Seventh Day: The right upper extremity was voluntarily used in feeding, causing wide swinging ataxia. The scalp wound was slowly granulating.

Eighty-Sixth Day: In the sitting position the trunk repeatedly listed to the right until it reached an angle of about 60 degrees with the floor. The animal then quickly jerked itself erect, usually with vocalization. It was obvious that tremor and dysmetria still remained in movement of the right extremities, especially in skilled movements. The head was usually held slightly inclined toward the right and slightly rotated, so that the chin pointed toward the left shoulder. The neurologic status had been stationary since the thirtieth day. The scalp wound was almost completely closed.

Subsequent Course.—This animal was observed until the one hundred and forty-first day, when at a third operation (March 9, 1935) the right premotor area (area 6a, upper part) was removed. Forced rolling movements were again present, and the animal could not walk or climb for two days because of the disorganized right-sided movements. On the third day a sitting position could occasionally be maintained, and the monkey could climb, swinging from side to side, half-way up the side of a 4 foot (1.2 meter) cage. Upright walking on all fours, with broad base, staggering and repeated falling toward the right, was possible on the eleventh day. The tremor and overshooting in the right extremities remained tremendous until the animal was killed, on the twenty-first day. On this day the animal could run fairly fast, but it staggered alternately toward the right and left and occasionally fell toward the right.

Autopsy.—The animal was killed under ether anesthesia. A liter of saline solution followed by 0.5 liter of Müller's fluid was washed through the vascular system through the left side of the heart. The brain and spinal cord were immediately removed and placed in Müller's fluid.

After fixation for several days the dura was carefully dissected away from the old operative areas. The excision of the premotor areas (6a, upper part) had been complete. The right cerebellar hemisphere remained attached to the brain stem only at its anterior margin. The right inferior and middle cerebellar peduncles had been completely transected. The superior peduncle appeared to have partially escaped; a bit less than its superior half remained intact. The brain was then sectioned, and Marchi and Weigert stains are being prepared of the basal ganglia, midbrain, pons, cerebellum and medulla and of the thoracic and lumbar portions of the cord.

Microscopic examination of the cortex excised at the second and third operations revealed the statigraphic structure of area 6a. However, the slides of the superior portion of the area extirpated from the left side showed several clusters of Betz cells in their extreme posterior aspect. These totaled 12 cells in all. This was also true of the area extirpated from the right side; the total number of Betz cells in all of the slides was 2. These extirpations therefore approached and at some points slightly encroached on the motor areas (areas 4).

In other cases removal of the premotor area (area 6a, upper part) subsequent to a contralateral cerebellar lesion caused marked exaggeration for long periods of the signs of cerebellar deficit, i. e., excision of the contralateral premotor area always restored in a striking manner the neurologic state seen immediately after the cerebellar operation. Compensation for cerebellar deficit would appear, therefore, to be a particular function of the premotor area. Some compensation, to be sure, occurs in the absence of the premotor region, i. e., the animals slowly regain the ability to walk and climb; but such signs as tremor, dysmetria,

titubation, broad-based gait and staggering station always remained pronounced in the premotor cerebellar animal.

If the lesions are made in the opposite sequence (i. e., premotor excision followed by section of the contralateral cerebellar peduncles, as was done in two animals [table 1]), the cerebellar signs following the second operation are more lasting and the compensation for the cerebellar deficit not as complete or as rapid as after a cerebellar lesion alone. Also the grasp reflex, which usually disappears from four to eight days after the excision of the premotor area, is restored by the cerebellar lesion. The course after the second operation may be illustrated by the following experiment.

EXPERIMENT 5 (cerebellar series, no. 28).—*Removal of the left premotor area followed by section of the right cerebellar peduncles; marked and enduring cerebellar tremor.*

The subject of the experiment was an immature male baboon (Papio papio), weighing 4.2 Kg.

First Operation (Nov. 24, 1934).—Extirpation of left premotor area (area 6a, upper part). This was followed by an uneventful recovery; the only obvious signs were motor paresis of the usual premotor type and weak grasp reflexes in the right extremities.

Second Operation (Dec. 10, 1934).—Section of right cerebellar peduncles. With the animal under sodium amytal anesthesia (2.4 cc. per kilogram), the cerebellum was exposed by the posterior approach. The vermis was retracted, and the right peduncles were cut through with a small curved knife.

Postoperative Course.—First Day: Complete recovery from the anesthesia had taken place. The animal was unable to change from the horizontal position; when attempts to sit up were made, the body was forcibly drawn to the right. The head was markedly inclined to the right, so that it tended to rest on the right shoulder. There were rotary nystagmus and complete incoordination of the right extremities.

Second Day: The neurologic condition was unchanged. The animal made determined efforts to use the right extremities in feeding, but the movements were accompanied by the wildest tremor and dysmetria. Forward progression was accomplished in a sprawling position by the animal's pulling itself along on its stomach, and progress was always marked by deviation toward the right. There was some difficulty in chewing; the jaws functioned intermittently and arrythmically.

Third Day: Nystagmus was obvious. The erect sitting posture was still impossible, and the animal still sprawled. The head was inclined far toward the right shoulder and presented bobbing movements toward the right. Tremor and dysmetria remained unchanged. There was no evidence of flaccidity. The grasp reflex was elicited in the right upper extremity. (This sign was more strikingly augmented in other experiments.)

Ninth Day: The head remained in a position of apposition to the right shoulder, with continued nodding movements toward the right. Attempts at sitting erect were immediately followed by marked listing to the right. The animal usually lay on the right side and occasionally pulled itself up to a sitting position. This position could be maintained if the baboon was supported by bracing the right shoulder against the side of the cage. The difficulty in chewing was still present

but was less severe. The nystagmus was less marked. Despite the tremor in the right extremities the animal continually tried to use them for feeding.

Twenty-Fifth Day: The baboon was very slowly gaining a greater degree of stability. It could sit in the rear corner of the cage, braced against the sides. Away from the corner it was able to sit by holding onto the sides and floor of the cage with the left extremities and leaning far to the right, with the right extremities abducted from the midline for support. The head inclined toward the right shoulder and was rotated so that the chin pointed to the left. Occasionally the head oscillated, seemingly spontaneously. The animal progressed forward by a mixture of walking and crawling, repeatedly falling toward the right. No resting tremor was seen, but the slightest tensing of the muscles of the right upper extremity brought forth obvious ataxia. Scratching with the right hand and foot was performed slowly and deliberately, with no obvious tremor.

Thirty-Eighth Day: There was no obvious change in the neurologic picture; the tendon reflexes were equally hyperactive; passively manipulating the extremities revealed no difference in resistance. The baboon was just beginning to assume semierect sitting and standing positions without holding onto the sides of the cage. The right extremities were held widely abducted from the trunk, resulting in a broad base and a lowered center of gravity. There were usually listing and lurching to the right when these positions were assumed.

Fifty-Sixth Day: Sitting, standing and walking were now possible without continual lurching and falling. The broad-based gait and veering toward the right were, however, obvious. The baboon was able to climb rapidly, but the ataxia on the right side remained marked. There was no nystagmus.

Subsequent Course.—The animal was healthy five months after the last operation. It had gradually regained some control over the right extremities, but the disability was far more profound than in animals with section of the cerebellar peduncles alone. The wide abduction of the right extremities from the midline in sitting, standing and walking persisted, as did the tilting of the head toward the right shoulder. Jumping and climbing were performed rapidly. When the animal was allowed to run free the disability in progression was striking. The animal proceeded in an oblique manner toward its goal; the legs moved forward in a lateral position in respect to the arms. The course was an extremely zigzag one, as there occurred frequent staggering and lurching toward the right. Running was slow, because of the high steppage gait and the abducted, ataxic extremities on the right side.

All skilled movements were performed with the left hand; the right hand was used as a whole, as small objects could not be manipulated with it.

Microscopic Examination of the Extirpated Cortical Area.—The cortical area removed at the first operation was sectioned and stained with the Nissl technic. These slides contained only premotor (area 6a, upper part) elements of the cortex, beneath which was a narrow strip of white matter.

Lesions of Frontal Association Areas (Areas 9, 10, 11 and 12).—To determine the effect of extirpation of the frontal association areas (areas 9, 10, 11 and 12) on the cerebellar signs caused by section of the contralateral cerebellar peduncles, the peduncles were cut in a young macaque (cerebellar series, no. 32), and areas 9, 10, 11 and 12 were then removed. After a state of equilibrium was reached in the cerebellar signs, frontal areas were ablated; the animal was up and eating

five hours after the procedure, showing no change in neurologic status, with the single exception that it could not conjugately deviate the eyes past the midline toward the right (injury to area 8). This caused a slight tilting of the head toward the left shoulder and moderate rotation of the head, so that the chin pointed toward the right shoulder. Thus the frontal association areas of the cerebral cortex of the monkey evidently take no part in the compensation for cerebellar deficit.

GENERAL COMMENT

After unilateral section of the cerebellar peduncles there was no detectable difference in the resistance of the extremities to passive manipulation, irrespective of the animal's position in space. The hopping reaction of the affected extremities was retarded, and steps, when finally taken, were large and dysmetric. The placing reaction was similarly slow, the correction being always very deliberate. These phenomena persisted without essential change in all animals studied. Magnet reactions were irregularly obtained from the affected upper extremity; they were not forceful and would change from day to day in the same animal. Further studies of the positive supporting phenomena are required. Nystagmus was also occasionally observed, but it was generally transient and was quite unlike the persistent and enduring nystagmus which follows lesions of the vestibular nuclei (unpublished observations). We believe that the nystagmus which sometimes accompanies lesions in the posterior fossa in man is due to medullary involvement or compression.

All the uncomplicated cerebellar animals performed some movements without tremor. Thus, when sitting or when in a horizontal position an animal could use either the upper or the lower limb for scratching. These movements were slow and deliberate as compared with those of the normal extremities, but they were without tremor or dysmetria. This is in agreement with the statement of Dusser de Barenne,[3] who noted that cerebellar tremor appears only in voluntary movements involving a change of posture and is absent in those movements, sometimes "voluntary," in which little or no postural activity is involved. It may be added, however, that choreiform shivering is observed in cerebellar animals on the side of the cerebellar lesion (Uprus, Gaylor and Carmichael,[23] Aring [24]).

It would seem clear from these studies that "cerebellar" signs so often observed clinically with lesions of the frontal lobes have a sound

23. Uprus, V.; Gaylor, J. B., and Carmichael, E. A.: Shivering: A Clinical Study with Especial References to the Afferent and Efferent Pathways, Brain **58**:220, 1935.

24. Aring, C. D.: Shivering and the Cerebral Cortex, Am. J. Physiol. **113**: 3, 1935.

physiologic basis and are due to involvement of the premotor cerebellar connections; finally, it is clear that the premotor postural mechanisms are closely related to those of the cerebellum. The anatomic basis of these relationships undoubtedly lies in the fact that the frontopontocerebellar tracts take origin from areas 4 and 6a, but principally from 6a (Levin [22]).

SUMMARY

Sixteen monkeys and baboons have been studied following various combined lesions of the cerebellum and frontal lobes; 4 monkeys were completely decerebellate. The results may be summarized thus:

1. Following decerebellation, tremor appears first in the head and later in the hands and legs. It comes on more rapidly in the monkey than in the dog or the cat and is restricted to movements which can be interpreted as "voluntary." There is some increase in extensor posture following decerebellation in the monkey, but magnet reactions are poorly developed. Flaccidity, or "hypotonia," has never been observed after complete decerebellation.

2. Removal of the principal excitable regions of the cerebral cortex, (areas 4 and 6a, upper part) subsequent to severance of the contralateral cerebellar peduncles abolishes ataxia (i. e., tremor and dysmetria) associated with "voluntary" movements in the affected extremities, despite the presence of vigorous reflex movements. In such a preparation there is marked extensor rigidity, the postural and righting reflexes are exaggerated and the animal is unable to walk.

3. Removal of the premotor cortex (area 6a, upper part) subsequent to the severance of the contralateral cerebellar peduncles ultimately causes marked accentuation of cerebellar signs and permanently impairs the animal's capacity to compensate for the cerebellar deficit.

4. Unilateral extirpation of the motor area (area 4) subsequent to a contralateral cerebellar lesion, on the other hand, temporarily abolishes and permanently depresses all signs of cerebellar deficit.

5. Removal of the frontal association areas (areas 9, 10, 11 and 12) subsequent to unilateral section of the cerebellar peduncles does not alter previously established cerebellar signs.

CONCLUSIONS

1. The nervous mechanism involved in the phenomenon of cerebellar tremor lies in the excitable cortex (area 4 and 6a, upper part) of the cerebrum.

2. The premotor cortex (area 6a, upper part) is the part of the frontal lobe most intimately concerned in compensation for cerebellar deficit.

3. The frontal association areas (areas 9, 10, 11 and 12) play no part in compensation for cerebellar deficit.

DISCUSSION

DR. ISRAEL S. WECHSLER, New York: Aside from the inherent interest in neurophysiology that these experiments present, they have, I think, valuable clinical application, and I shall limit my remarks to the clinical aspects of the problem.

I think it is correct to state that the initial ataxia in some cases of lesion of the cerebellum frequently subsides despite the fact that the pathologic process continues to advance. For instance, in cases of tumor of the cerebellum, one observes considerable ataxia in the beginning. After a while, the ataxia seems to disappear, despite the fact that the tumor continues to grow. I always wondered why it was so. The experiments made by the authors seem to give the answer, namely, that there is a certain degree of compensation by the cortex.

The question of why the ataxia and the tremor disappear following the removal of the motor area itself I think is answered by analogous observations in cases of other clinical syndromes. It is a fact, for instance, that the tremor of paralysis agitans will disappear if hemiplegia develops. I think it is equally true that many abnormal and voluntary movements—chorea, choreo-athetosis and others—disappear when hemiplegia occurs and reappear when the hemiplegic syndrome subsides. This clinical observation is particularly true in children, who on recovery from hemiplegia present abnormal involuntary movements. The same thing holds true in persons with the thalamic syndrome, in whom the mild degree of involvement of the pyramidal tract recedes as the lesion clears up.

The question then presents itself: Is the pyramidal tract necessary for the mediation of the impulses which permit of the existence of all abnormal involuntary movements? Anatomically, it is difficult to answer affirmatively, because in cases of cerebellar ataxia, for instance, it is assumed that the impulses go from the cerebellum to the nucleus ruber and descend in the rubrospinal pathways.

The question of ataxia on the basis of a lesion of the frontopontocerebellar pathway is clinically somewhat different. While it does occur, it is not nearly so common clinically as one would expect from what is known of the physiologic pathways.

The question also arises as to whether the extreme rigidity does not in itself impair the tremor. It seems to be true that the reason the tremor reappeared after ipsilateral ablation of the motor cortex is because there had already been sufficient recovery from the contralateral lesion and the animal was compelled to use the arm which at the given moment was in a better condition to execute movements. In other words, in order to have any ataxia at all, any tremor at all, one must be capable of having movement. That is exactly what happened in these cases.

The question of tremor and posture is another one which, to my mind, is of some importance. Evidently certain types of tremor depend on postures, on attitudes. Some types of tremor, of course, occur at rest; other types, particularly ataxic tremor, such as occurs in persons with multiple sclerosis, depend on position and attitude. What relationship tremor has to posture I am not able to say, but I do think that there is some relationship.

I do not know whether it is fair to say that the premotor area always compensates for ataxia. It seems to me that there is a reversible reaction between the cerebellum and the premotor area. I do not know whether it is right to infer that the cortex always inhibits tremor or ataxia. What happens in some cases probably is that with the ablation of the premotor area there is a release of lower mechanisms which permit of the production of one type of ataxia.

One other thought occurred to me in connection with ataxia, namely, the question of alcohol. Acute alcoholism produces ataxia. Chronic alcoholism also affects the cerebellum to some extent. Whether acute alcoholism also affects the cerebellum or whether the ataxia is due to the involvement of the cortex alone is a moot point. It may be that alcohol attacks the frontal lobes and also the cerebellum.

It seems to me that if further proof is necessary that there is a distinction between the motor and the premotor region, a distinction the existence of which Walsh denied in a recent article, it is furnished by the experimental evidence adduced by Dr. Aring and Dr. Fulton.

DR. FRANCES C. GRANT, Philadelphia: I was interested in this presentation of Dr. Fulton's particularly from the standpoint of trying to correlate the clinical findings in cases of tumor of the brain with the results that he has had with his physiologic experiment.

In an earlier communication, in which an analysis was made of twenty-seven cases of cerebral tumor in which from the clinical signs the growth had been incorrectly diagnosed as cerebellar, two explanations for these false localizing signs were given. Since in all these instances intracranial pressure was increased, the assumption was made that pressure on the cerebellum through a sagging tentorium or a downward thrust against the cerebellar peduncle by the cerebral hemispheres herniating through the incisura produced symptoms of cerebellar involvement. That these cerebral tumors might of themselves, owing to their intracranial position, produce "cerebellar symptoms" was not, in the light of evidence then available, considered probable. This necessary evidence seems to have been furnished by the paper just presented.

My former contribution and the literature have been briefly reviewed for the purpose of determining, if possible, the positive symptoms usually attributed to cerebellar involvement. Bruns, in 1892, reported four cases of cerebral tumor closely simulating cerebellar disease. One of the tumors was bilateral, and the other three showed infiltrating unilateral lesions involving much of the frontal region. The ataxia was bilateral. In Stewart's four cases, in which the tumors seemed to be chiefly in the prefrontal areas, the symptoms indicating cerebellar involvement were contralateral. Condon described four cases, two cases of tumor, one case of an abscess and one case of hemorrhage, in which symptoms of cerebellar involvement were bilateral. The lesions were fairly acute and lay on or near the surface of the frontal lobe in the premotor area. Williams reported three cases, two of bilateral infiltrating tumor in the frontal region and one of a subdural hematoma in the midfrontal and prefrontal regions, in which bilateral signs of cerebellar involvement were produced.

Of the twenty-seven cases reviewed in my report, in nineteen the growth was in the frontal region or in the midline behind or in front of the pituitary. In eight it was located in the parietal or occipital area. Most neuro-anatomists agree that the pontocerebellar pathways arise from cells well forward in the frontal cortex and swing inward toward the midline, forward and into the pons, where connections are formed with neurons crossing to the opposite cerebellar hemi-

sphere, although some of the fibers may run to the ipsilateral cerebellar lobe. This midline deviation of the fiber tracts may account for the fact that of these nineteen incorrectly diagnosed tumors, five lay near the midline in the thalamus or basal ganglion.

Hare, in a recent review of fifty cases of tumor of the frontal lobe, found five in which marked symptoms of cerebellar involvement were produced. In three of these cases autopsy showed involvement of both frontal lobes; in two operation or pneumoroentgenograms indicated that the frontal areas were the site of the tumor. Four of the five patients showed unilateral "cerebellar symptoms," and one, bilateral signs. In a recent review of cases of tumor of the frontal lobe from the neurologic clinic of the University Hospital, symptoms of cerebellar involvement were noted in 49 per cent. Bilateral signs were present in the majority of these cases, although in only one case was the tumor bilateral. An impression is obtained from this review that symptoms of cerebellar involvement appear much more frequently in cases of tumor involving the superior and lateral aspects of the frontal lobes than in cases in which the growth lies posteriorly in the brain or in the frontal lobes.

It seems clear, therefore, that tumors affecting the motor and premotor areas can and do produce manifestations of cerebellar involvement, thus confirming the work of Dr. Aring and Dr. Fulton on clinical grounds. But it must always be remembered that the lesions produced by these investigators were carefully and accurately placed to remove only certain specific areas and to excise them clearly and completely.

With this fact in mind, the answer to the question why more tumors of the frontal lobe do not produce cerebellar lesions may be analyzed. These tumors grow as they please and do not confine themselves to definite areas. When an attempt is made to correlate clinical signs and pathologic findings, it must always be remembered that a history of tumor may extend over many months and that vague evidence of cerebellar involvement may be overlooked. However, the data presented by Aring and Fulton are clearcut and definite. Certainly intracranial pressure as a factor in the production of these cerebellar symptoms can be eliminated. It would seem that this research has afforded definite grounds on which one can explain symptoms of cerebellar involvement in cases of frontocerebral tumor and has produced confirmatory evidence for the presence of a frontocerebellar pathway.

Dr. Henry Viets, Boston: It seems to me that for the first time definite light has been thrown on the relation of the frontal areas and the cerebellum. By removing the cerebellum on one side or by cutting the peduncle and then removing the premotor area on the other side, the cerebellar deficit is definitely increased. The deficit is not increased, however, when the frontal lobe is removed, nor is it increased when the motor area is removed. In other words, there is an addition to the "syndrome of the premotor cortex," which I am glad to see that Dr. Wechsler, in his discussion, accepts.

Dr. Stanley Cobb, Boston: May I speak about nomenclature? This is thoroughly mixed up. The misunderstandings are largely due to lack of precise use of terms. As I have listened here to the authors and the discussors I have heard them use the word "ataxia" when they meant "asynergia." I have heard them say the "frontal lobe" was removed when they meant that the anterior two thirds of it was removed. I have heard "motor area" used to mean three different things, and "premotor area" and "pyramidal tract" were used equally loosely.

There was even a discussion of "cerebellar symptoms" arising from lesions of the frontal lobe! This colloquial talk may be genial, but it is not scientific.

DR. JOHN F. FULTON, New Haven: I am in hearty sympathy with Dr. Cobb's plea for precise definition. May I point out, therefore, that in our paper we have used "ataxia" to indicate the total cerebellar syndrome, and that we regard tremor (or "astasia" as Luciani designated it) as the outstanding symptom of the cerebellar picture?

To take up Dr. Wechsler's first point, namely, whether the pyramidal tract is essential for voluntary tremor, I believe it is not essential, since one can remove area 4 (motor area), in that way destroying all corticospinal innervation from the Betz cells (and about nine tenths of the pyramidal tract innervation of the cord) and in these circumstances cerebellar tremor still remains, in somewhat diminished form.

With regard to the frontopontocerebellar tract, the recent work of Dr. Poljak and Dr. Levine in Chicago indicates that this fiber system arises from both area 4 and area 6, probably chiefly from area 6, but these workers are unwilling to commit themselves at present as to the dominant site of origin.

With regard to rigidity from the cortical lesions in the cat, after one has completely removed the cerebral hemisphere from a decerebellate cat, the rigidity at first is marked; it then diminishes, and the cat is able to carry out vigorous reflex movements in the affected extremities and those movements are devoid of tremor. In the decerebellate monkey the extreme rigidity which follows a cortical lesion would prevent tremor, but the intense rigidity later diminishes and tremor does not reappear.

Passing to Dr. Grant's and Dr. Viets' comments, it is gratifying to realize that these observations appear to throw light on the old problem of the frontal lobe in relation to cerebellar symptomatology, and I must thank them for their illuminating discussion.

INVESTIGATIONS WITH DISTRIBUTIVE ANALYSIS AND SYNTHESIS

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In the investigation of the human personality one deals with a psychobiologically integrated whole. Methods which have proved valuable in other fields (e. g., in experimental work in physics and chemistry) may therefore be of little value. Psychiatry must find its own methods and scientific rules, derived from and adjusted to the material with which it deals. Methods can be considered valid which lead to a control of the facts. In addition to the objective data of this material, subjective experiences must also be considered and evaluated. Introspection and subjective description, while not always critically dependable, are nevertheless valuable amplifications of factual knowledge and deserve careful scrutiny.

Psychiatric studies must always be linked with treatment. One should never make a patient worse or retard his recovery, and in a case in which further investigation might do this it should be suspended or abandoned. Unforeseen difficulties in treatment or opportunities for adjustment often make it necessary to modify the procedure, and a study which will fully satisfy investigative needs and ambitions is possible in only a few cases. However, in cases offering limited possibilities one may sometimes confirm points which have been gained in the more thoroughly studied cases. In every case one must consider the setting and realize that factors which are important in one setting may be less significant in another or that what is important at one time may later become submerged or lose its influence. There is danger that one may generalize and put down as fundamental facts and laws for all cases what one has found to exist in a few thoroughly studied cases. Another danger is dogmatism; it is necessary to assume a pluralistic attitude.

DISTRIBUTIVE ANALYSIS AND SYNTHESIS

This procedure, which has been proposed and outlined by Adolf Meyer, is the most natural approach to the investigation and correction of personality difficulties on a psychobiologic basis. It is an analysis of all the factors involved, with attention to the patient's complaints, the psychodynamic and somatic features, the situational conditions and the constitutional make-up. The patient's needs are constantly considered,

and the analysis is terminated or suspended whenever it seems best for the patient. The analysis is distributed by the physician along various lines. These are selected after a careful preliminary study in a few consultations or during hospital observation. The physical and mental status, the development of the illness, the actual situation and the constitutional history form the basis for the plan of investigation. The material which is obtained through the analysis is used constructively during the treatment. This synthesis is attempted at the end of every consultation, after certain phases of the investigation and treatment have been reached, and especially at the end of the completed study.

Such an investigation must be on a pluralistic basis; it cannot proceed rigidly along preconceived lines. Unforeseen difficulties or opportunities for attack may arise at any time and may make it necessary for the physician to change his procedure. Every situation which offers opportunity for action should be investigated. As a rule, much attention is paid to the complaint, which is made the starting-point. Formulation of the complaint should include the complaints of the patient and of the family and the findings of the physician. This material is then formulated to the patient in such a way as to gain his cooperation and allow him to understand the physician's procedure. Consideration is given to the patient's subjective needs and to the complaint problem in its broadest sense, with evaluation of the rôle of life situations and various personality features and phases of development. One has to determine which features of the personality are modifiable and which are constitutional or so ingrained that they cannot be modified but must be used to the best advantage. Periods of success and contentment as well as failures are studied for the factors which played a significant rôle.

Psychogenic factors are traced through concrete situations in order to determine their actual significance. Characteristic situations are thoroughly analyzed. In many cases the symptoms may be carefully studied; on the other hand, the study and treatment are never merely symptomatic. It may sometimes seem best to neglect the symptoms entirely and reach an understanding and adjustment in an indirect way. When it is desirable to produce tension and thus overcome resistence and increase the need for discussion, the patient may be advised to suppress his symptoms actively. (Suppression is also important for reeducation.) Situational changes and the creation of specific situations are valuable expedients from an investigative and therapeutic point of view. They allow the patient to become aware of the various ways in which he may react, and they stimulate a healthy interest in the significance of these reactions.

Acute problems always demand immediate attention. I believe that the physician's first duty is to establish security in the patient. When signs of disorganization or threats to security appear during the analysis, the investigation will usually need to be directed along less dangerous lines and analysis temporarily be replaced by synthetic treatment. The type of illness and the individual setting will determine whether the analysis of disturbing topics can be safely resumed at a later period.

The physician assumes full obligation for the twenty-four hour life of the patient and cannot consider only the observations made at consultations. Objective data are therefore collected from other sources. The patient is aware of this but is reassured as to the confidential nature of the discussions. Notes are always taken in the patient's presence. One should not depend on memory and at the end of the consultation write a summary of the material obtained. Every patient can understand the need for such notes. When difficulties arise—for example, those due to suspiciousness—they are immediately made the topic of investigation. These notes allow the physician to bring to the patient's attention any discrepancies with previous statements. One should formulate carefully, however, that the original statment was given honestly, according to the patient's understanding at that time, and that now, with a more inclusive understanding, a better perspective has been reached. If it appears that the patient's sensitiveness may not have permitted him to tell what was clear to him, this attitude is then studied.

The technic can be direct or indirect or a combination of both. In direct analysis one uses questions which turn the patient's attention to certain problems. Whatever he offers is then used for further questioning. It is considered wise to use the patient's own words in formulating questions. The notes allow the physician to use statements which the patient himself has made. In some cases best results are obtained by offering the patient a formulation of problems as they occur and by asking him to scrutinize it carefully to find whether it fits his own case. In other cases, especially with patients who have a tendency to be vague or circumstantial, only brief answers are expected. These are then immediately utilized for further questioning. The patient's attention is drawn to any delay, and he is advised to tell his thoughts without critical evaluation and without allowing himself to suppress thoughts for emotional reasons. Argument is carefully avoided. When interpretations are necessary, they are always offered in the form of questions. The patient must decide whether they suit his case and accept or reject them.

Indirect analysis makes use of the procedure of free association and the study of dreams, mistakes and forgetfulness. Investigations using free association may be directed more or less openly by the

physician, as the condition indicates. It is frequently helpful to interrupt the flow of free associations after a short time, ask for associations with another inherently related topic and, after a short time, return to the original topic. In such a way, the desired solution may be found relatively easily. This method is a distributive use of free association. In some cases an analysis making use of complete and undisturbed free association for a limited period or for the whole course is indicated. The free association experiment of Jung, adjusted to the American setting, and the material obtained from the Rorschach test are used in a similar way.

In both direct and indirect analysis the physician may terminate the analysis of a particular problem because it seems premature or may take too long. One can frequently proceed more rapidly after the patient has obtained insight along other lines through the investigation of other life situations.

The goal of treatment is to establish in the patient a healthy self-reliance combined with adjustment to the group. In order to carry out the investigations and the treatment, a physician needs thorough psychiatric training; otherwise, he will be unable to outline the topics for investigation. The diagnosis must include the main reaction type, the phase of the illness, the personality and the general setting. A work sheet is considered essential for such a plastic and constantly varying procedure.

The contrast to other modes of investigation is definite. The physician-patient relationship which psychoanalysis cultivates in the form of transference receives constant scrutiny. It is not made the basis of the treatment. Instead of developing a dependence on the physician, one tries to dissolve dependence whenever it appears and to establish self-reliance. Analysis and synthesis are actively directed by the physician. The factors of resistance, repression and regression are accepted wherever they occur but are not assumed to be dominating principles in personality disorders. A distinction is made between the healthy repression of experiences, to which the patient has made an adjustment, and the unhealthy repression which serves as an avoidance of understanding. The dynamic value of the repressed material is then evaluated accordingly. Infantile sexuality is viewed from a similar pluralistic point of view. The analysis is not guided by the dogmatic need to find certain sexual factors and developmental phases in every one, although the physician recognizes them and studies them when they actually occur. Self-assertion and an exaggerated need for independence, strivings for superiority, compensatory reactions and sexual strivings or other personality features are studied in the same way. Suggestion and hypnosis, catharsis and various other approaches are utilized if they seem indicated or if special interests demand their use.

ANALYSIS OF PANIC REACTIONS

The two following cases illustrate the technic which was used in the investigations and also offer an outline of the therapeutic procedure. These presentations are necessarily limited to the essential facts in each case. Many points are not mentioned or are merely touched on because they do not play an important rôle in these cases. The genetic-dynamic understanding in both cases is based entirely on factual material. They are not interpreted by the use of dynamic principles or factors which are assumed to be of general or specific importance.

The first case is an instance of paranoid panic reaction, occurring during a period of strain in a setting of prolonged insecurity. The panic subsided in two weeks, but doubt and uneasiness persisted for several months. The investigations were carried out by direct questioning, guided by the problems which the patient offered or which appeared during the treatment, by the situations and experiences which play a rôle in every one's life and by various tendencies which are important in every personality.

CASE 1.—A merchant, aged 27, unmarried, who had been in this country illegally for three years, felt insecure and was constantly afraid that he would be caught and deported. His plan was to marry an American girl, since he believed that this would establish legal security. He had a good position, in which he worked hard, and in addition he took courses in accounting and economics at night-school. In the fall of 1933 he became a member of a firm organized by his brother; there was constant friction with the other partners because of his aggressiveness and self-assertion. To the seasonal lull in business in the spring of 1934 he reacted with considerable discouragement, believing that others would blame him for inefficiency. He was worried over this and hurt by his brother's reserve toward him, which was in contrast to their relationship in childhood (the patient had not seen his brother, ten years older than himself, from puberty until he came to the United States). On August 16, when he was visiting a girl in her home and found her willing to indulge in minor sexual intimacies, the patient wondered whether he had been tricked and might be blackmailed. He believed that he was watched and made frequent misinterpretations. His fear mounted, and after a week he called on his brother for help. He thought that detectives were about, that the house was wired for people to listen in on him and that pictures were taken of him through the windows. When I saw him on August 24 he was at first suspicious and on guard but soon talked freely about his observations, stating that he was depressed and "full of fears." He was anxious to enter the hospital, where he would feel protected.

In the hospital marked insecurity, suspiciousness and ideas of reference and fear were the outstanding symptoms. After three days of reassurance, with opportunity for ventilating his preoccupations and fears and distraction by an active hospital routine, the fears and paranoid symptoms subsided. After hospitalization for a week discussion of the factors involved was begun. The development of the illness, life situations and personality setting were reviewed, and the patient gained considerable insight. He had to leave the hospital after twenty-four days, when he felt at ease and ready for work. When he returned to his home town, some suspiciousness recurred and persisted for a month. He returned

to the hospital for consultation treatment every few weeks. The understanding of the factors to be presented was obtained during this period. The investigation was not as far reaching as I should like, because the patient was unable to spend enough time with a physician and I did not believe that this patient could be safely pushed. It was sufficient, however, to clarify the factors involved in the paranoid panic reaction and to establish security for future life.

The study was carried out by direct questioning. Whenever I came to topics for which the patient did not seem sufficiently secure, I offered a temporary formulation and turned to less dangerous topics. After better security had been established, I returned to the previous discussion. The discussion soon turned from the precipitating factors to the personality make-up, to formative factors in the past and to the expectations for the future, to imaginations and actual performances, abilities and standards. During both the hospital and the consultation treatment the material obtained in each discussion and its constructive utilization were carefully formulated and reviewed with the patient. During the acute phase the physician offered definite advice whenever this was necessary. Later, the patient was urged to find his own solution.

In early childhood his self-assertion and craving for admiration had been outstanding traits; these tendencies were fostered by the parents. As he grew up in a small Jewish community in a European country, his ambition was to emigrate to the United States and achieve the success which his father, who was his ideal, had failed to reach during his five year stay in America. The patient was outstanding scholastically and was snobbish toward other children, having no intimate friends and confiding in no one but his brother, who was ten years older. This brother was like a father to him in childhood (from 4 to 8 years) during his father's absence in America and again during the time of stress after the World War. (When the patient was 12 years old, his brother returned from America, where he had made a success scholastically, and remained at home three years.) "He was my teacher and the director of my life, even as a child." The patient had a high standard of loyalty to his brother and confided fully in him, expecting the same of him. When he reached the United States in 1931, the patient felt deeply hurt because his brother had become attached to a woman and no longer returned his confidences. This woman and his brother put up the money for the business venture. Both insisted on a partnership with a successful manufacturer in order to restrict the patient's aggression. Although this motive was denied at the time, the patient suspected it, and his admiration for and devotion to his brother gradually changed into resentment and hate. He felt less strongly toward the woman, as he was only a business acquaintance and she did not need to treat him as a loyal friend.

His goal had always been achievement in business and admiration for his success rather than power or wealth. Interferences with his "sense of direction" were resented and felt deeply. He had never been able to forget such incidents, and he continually went over these situations in his imagination. This was especially marked during periods of less activity (his sense of insecurity and tension became more pronounced during the lull in business in the spring).

To be able to stay in the United States was of utmost importance to him, because here were the world center of his type of business interest and opportunities to reach the top. During a five year stay in another country (1926 to 1931), where he had become naturalized, he felt at ease and secure; the illegal status in the United States was felt to be a constant threat to success. He therefore avoided fellow-countrymen and frequently changed his address to avoid being found out. Being a sociable person, he felt a certain loneliness because he was afraid to form friend-

ships. This again was in contrast to his previous life. Realizing his aggressiveness and fearing that other business men might try to prevent his still moderate but increasing success, he was afraid they might report him to the government if they knew his legal difficulties.

While in the country in which he had become naturalized, he was induced into sexual relationship by the wife of a friend. He was unable to break with her, partly because of the sexual gratification and partly because it might have meant the loss of his position, which allowed him to receive unusually good training for his future work (he worked for her relatives). Coming to the United States meant an opportunity to free himself and to be with his brother. Deportation meant exposure to the danger of becoming her lover again (he feared this because of his still persistent desire for her). This relationship with his friend's wife was degrading to a man with his high standards of loyalty and honesty, and he had never been able to lose a marked reaction of guilt to it.

His sexual life had been fairly passionate. During adolescence (from 14 to 18) he indulged in frequent masturbation with heterosexual content. Before meeting his lover and during periods of struggle against giving in to his and her desires, he had regular intercourse with prostitutes, obtaining full satisfaction. Since 1931 he had abstained completely except for frequent masturbation with imaginations of the woman and of a girl in the United States with whom he fell in love. Masturbation seemed degrading to him as a mature person, but it was resorted to as a relief from tension. He no longer visited prostitutes because he was afraid that this might lead to legal complications. His high concept of virginity prevented him from seducing a girl. I was unable to determine the specific formative factors of his woman ideal. Discussion of the mother relationship revealed nothing of special importance. Homosexual trends were not elicited, but there were indications that they played a certain, although not important, rôle.

During the past two years the patient had courted a girl with marriage in mind. He began to confide in her as he had in his brother, but with increasing doubt (later shown to be justified) that she really understood his interests and plans. During a party in January the girl embraced him. The patient withdrew from her for several weeks, unable to decide about proposing marriage. When he approached her again she rebuffed him because she had felt slighted. This worried him greatly, as he believed that he had done a decent girl an injustice. In his panic reaction he was sure that this girl had betrayed him to the government. The sexual indulgence with a social acquaintance on August 16 was a special precipitating factor, because he had always feared on such occasions that the girl might claim that he was then under obligation to marry her. This fear was the expression of guilt when he indulged in sexual intimacies with girls of his own group, even though they were known to recognize few sexual restrictions.

Since childhood the patient had paid much attention to his appearance and to keeping his body in perfect condition. This perfectionistic attitude appeared in everything which had to do with his personality. With rare exceptions he thought that he had reached his standards and therefore felt at ease with others. Although cautious, he had no tendency to suspicion until he came to the United States.

He had always had a great thirst for knowledge. This and his desire to be admired for his broad education were the factors which pushed him into an unusual amount of night study to prepare for college work. His intense curiosity and need to inquire into things contributed to the formation of suspiciousness during periods of tension.

The paranoid panic was the climax of a long period of insecurity. The illegal status threatened the success which was vital to the patient, and deportation might

also mean recurrence of a situation which was ethically unbearable to him. The constitutional factors of self-centered self-assertion, with unwillingness to be under obligation to any one, and the need for loyalty and high ethical standards were of utmost importance. To speak of a sexual or anticipation panic would merely characterize more incidental situational and personality factors.

Through this treatment the patient obtained an understanding of the important personality strivings. He became willing to modify his ambitions and developed better self-reliance and a more tolerant attitude toward his brother. He realized the need for more social contacts and recreation in group activities and was able to adjust his life accordingly. At the time of writing his sexual life is well controlled; occasional sexual relations with casual acquaintances seem to be satisfactory. A year after discharge he was able to correct his illegal status.

The second case offers a more far reaching understanding of the dynamic factors which enter into panic reactions. The young woman suffered from phobias, and during a distributive analysis carried out by indirect methods two definite brief panics of a disorganizing type developed. The treatment led to complete recovery, with insight into the important factors and situations.

CASE 2.—A married woman, aged 32, came to consult me on Oct. 1, 1928, because of frigidity and phobias (inability to travel on boats and trains) and marked fear of death. General insecurity had developed about 1921 (at the age of 25), and the patient had become increasingly tense and was frequently panicky. In the first few consultations a general picture of her illness and life setting was obtained. She was the third child with four brothers and from early youth had been put on the defensive. A need to behave and to be like a boy had developed. Although she excelled physically, she was never fully accepted by her brothers. She had always felt the need of social contact and appreciation by others, but because of her self-assertive behavior she had never been able to fit into a crowd and had felt lonely since childhood. A tendency to self-consciousness and concern about the impression she made on others appeared during the preschool age, and later a definite inclination to suspicions and misinterpretations developed. This girl was brought up rigidly by a successful father, who was of a similar make-up and never succeeded in "getting close" to his daughter. He died in 1923 and left her an independent income. The mother, who was interested only in social life, emphasized the need of being appreciated by others for one's beauty and ease of social behavior (she died in 1925).

Owing to her reaction with spite to this background, the girl had several superficial love affairs in late adolescence and, at 20 and 28, heterosexual relations with two men. With both men she was unable to obtain orgasm. She married at the age of 31 (in 1927) and blamed her husband for her frigidity. Masturbation had played a rôle in her life since the age of about 18; she had a "crush" on a girl at 14.

This story, which was obtained in the first three interviews, showed clearly that the frigidity and phobias had to be viewed as a general personality problem. A study of the personality make-up and its development from childhood seemed essential. It was therefore formulated to her that her sexual difficulties as well as her fears could be understood and corrected only on the basis of an understanding of the personality. Features which impressed me as deserving special attention were self-assertion, a desire to excel, difficulties in adjustment to the group and a tendency to resentment and spite reactions. The features of resent-

ment and spite reactions were not pointed out to her because she obviously resented the need for psychiatric treatment or any suggestion that she might not be able to understand and deal with herself. During the interviews the patient was always on guard, repeating the physician's questions to make sure she understood correctly, never offering more than was asked for and stating repeatedly that she was skeptical as to the value of these discussions. I believed that an indirect approach would be more helpful in obtaining material not selected by the patient's critical evaluation. Free associations were used, not to reveal to the patient an unconscious life but to have her recall experiences and strivings of the past, the analysis of which would not immediately put her on the defensive and which would allow her gradually to understand her personality reactions.

The patient easily learned the use of free associations. Problems and formulations were offered in the form of a question, and she was asked to find answers through free associations. These questions were frequently of a provocative nature but were always taken from the material which she herself presented, her own words being used. In the first hour I asked her for what she needed help, advising her to tell whatever came to her mind. This led to statements of needing help for "fear of the disgustingness of death," which was related to "exaggerated physical pride" and the wish that nothing ugly should happen to her body. Instead of letting her pursue this, which caused her considerable difficulty, I asked her to consider whether there might be additional problems. After many side-stepping associations, she mentioned "my struggle and my loneliness in childhood"; "the deaths in my family," and "our [family] emotional relationship." When she was asked to return to her fear of death, the patient mentioned her tendency to think in pictures and her enjoyment in indulging in elaborations and wondered whether she might enjoy self-torture. Directed to see what death meant to her, she had marked difficulty and finally ended with the statement that death is "nothing." She became increasingly tense and restless, and when directed to this observation and her obvious difficulty in proceeding, she expressed anger that she had to undergo a treatment which interfered with her life. This led to a reformulation of the goals of treatment, using her own statements to illustrate the need for treatment. This example of the use of free associations illustrates the principle of distributing the investigation along the lines which seem most profitable to the physician. This, however, does not exclude the possibility of letting the patient proceed uninterruptedly for a whole hour, if it seems desirable. The patient's thoughts are usually interrupted when the physician has obtained what he had planned. Occasionally an interruption is necessary because the patient's attention has to be directed through a question to something important which has not been discussed and which, if left to the patient, would be merely touched on at the time.

For example, when she was asked about the meaning of wealth and social position, the patient talked about her brother's interest in fashionable society and her dislike for such people because "they have no loyalty in sexual life" and overindulge in drinking, eating and luxuries. After about thirty minutes of talk along this line she was asked whether she also applied her rule not to overindulge to her imaginations. This led to recognition of her ill controlled imaginations. She then, however, returned to the discussion of the general attitude of wealthy people. It would not have been wise to increase the patient's self-assertive defense by returning to the previous topic. On the other hand, little seemed to be gained by letting her proceed further. I therefore asked her about her concept of loyalty, which she emphasized so strongly, as applied to the relationship with her husband during the engagement period and since marriage. She defended her flirtations as justified means of increasing her husband's sexual power by jealousy. As this happened

at the end of the hour, the question was left open. The next day it was again taken up and led to an understanding of her "wish to be more dishonest." The next day her concept of freedom was taken up.

Dream analysis was not used in this case. In many cases dreams are analyzed thoroughly, the physician taking an active part by advising the patient to change to another part when what seems necessary to the physician has been obtained. At other times, the patient is urged not to change because he wants to attack another problem merely in order not to have to overcome his resistance. It may also happen that, owing to promising progress, a special part of a dream or the whole dream leads to a far reaching analysis, which lasts several days. Dreams are thus not used to prove a special theory—for example, that of wish fulfilment—but to obtain facts which can be used in the form of an illustrative summary.

At the end of each consultation (this patient was seen every day except Sunday for one hour, the whole treatment lasting four months), the patient was requested to formulate briefly what had been obtained, or my own formulation was offered in the form of a question. This was occasionally done as a provocative measure to stimulate the patient and overcome at the following hour a resistance which had impeded progress. There were times when the patient left without a formulation because the material obtained was already clear to her. She was strictly advised to avoid talking or thinking about herself during the intervals between visits. A healthy routine, in which recreation was carefully evaluated, was discussed with the patient at the beginning of the treatment, and she was urged to adhere strictly to the principles of this plan. Modifications which appeared desirable during the course of treatment were taken as problems for investigation. This prescription of routine was especially important in this case, as the patient was from another town. No medication was employed during the treatment. Temporary difficulties of sleep and increase of fear were always considered the expression of emotional disturbances due to the material under discussion, and the analysis was guided along the necessary lines. Complete sexual abstinence was urged for the first two months to enable the patient to gain an understanding of sexual control and to avoid setbacks in the correction of her frigidity which might result from permitting sexual relations before the personality had been adjusted. She stated that she accepted alcoholic drinks only because of her fear that refusal would make her conspicuous, and I therefore advised her to abstain until she had gained self-confidence and ease (during the last six weeks of treatment this restriction was no longer necessary). Her repeated reactions of resentment and anger to these restrictions were several times carefully studied. Repeated analysis of actual recurring situations is valuable if each time, owing to the progress which has been made in the meantime, it leads to a more inclusive understanding. Mere repetition, however, must be avoided. This is more likely to occur in conversational methods than in indirect investigations.

The patient recognized early in the treatment (during the first week) her need for independence and jealous guarding of her right to be an important factor, but she was not willing to admit that this might be a matter calling for adjustment. The study of her adolescence and childhood showed constant manifestations of an attitude of opposition. Frequently she had indulged in impulsive acts to find out how her father would react (for example, drinking in adolescence, joining undesirable crowds and going to socialistic meetings), and she used similar means during the treatment to gain an understanding of the physician. Curiosity concerning human behavior and a great hunger for knowledge (literature, economics and social conditions) had been present and had increased since adolescence.

The following additional data were given during the first ten days: Her attitude to her father had always been one of hate and worship, of antagonism and independence. The older brother had played a similar rôle, especially after the father's death (in 1923). Early in the treatment the patient recognized that the same attitude was developing toward the physician. These facts arose many times in discussions, during which the principle was preserved that each discussion had to bring out something new. They led to an understanding of her attitude toward authority and to men in general, who to her represented authority, to treatment and to the physician and to the past but still persisting influence of her dead father and brother.

She believed that she needed help most urgently to get rid of her fear of death—"death is disgusting because it means physical ugliness and nothing." "In death the body is stiff and cold; people seem to be afraid of it." The patient wanted people to like her and could not bear to think of people shrinking from her body. During this discussion she asked to be allowed to smoke. It was pointed out to her afterward that she asked for cigarets only when distressing topics came up, and she was advised to stop smoking completely because it apparently helped to smooth over the disturbances, whereas the aim was to discover them.

The study was first directed to an understanding of her dependence on the opinion of others in order to establish more confidence in herself and with it a higher degree of security. At this time (October 9 to 14) the patient's tension increased; sleep became disturbed by fearful dreams of being attacked by wild animals. These symptoms and outbursts of homesickness, which were offered as an excuse to terminate the treatment, were recognized as danger signals. The patient was urged to endeavor to gain an understanding of these disturbing symptoms, which had appeared occasionally before she came to Baltimore. When she was asked about her goals in life (on October 17), she stressed primarily the desire to be considered clever. She resented that the ability to fight and to work aggressively, to be sure of oneself, to be independent and to protect others were considered male characteristics; female tendencies were the need to receive sympathy and to be comforted, to be soft of body and to bear children. She was unwilling to consider the possibility of modifying this attitude. The next day (October 18) the patient spontaneously mentioned masturbation (intravaginal) in childhood and the practice of masturbation since marriage. She was resentful of these occurrences because they had lowered the value of her body. She was advised to study her attitude to her body, which she wanted to be perfect, and her attitude to illness. This brought out her lack of sympathy for her mother during her prolonged illness (from 1920 to 1929) and the patient's impression that the attending physican had been primarily interested in his financial remuneration. The opportunity was utilized to investigate her resentful attitude to physicians in general, and it led to the recognition that she was guided by impressions and not by facts. This helped to lay the foundation for a firmer and healthier relationship with her own physician. On October 19 the present treatment was again discussed as well as her statement that it was lowering to see a psychiatrist. When asked whether she might have a need for self-assertion beyond what was desirable, the patient talked about it vaguely. She then realized suddenly that she was striving along what she had mentioned as male trends of character, and a few minutes later she angrily accused the physician of trying to prove that she was homosexual (Oct. 19). A few carefully worded questions brought out that her tension and fear had reached the degree of a slight panic, with considerable difficulty in concentration, insecurity and vague suspiciousness directed toward her friends. I discussed homosexuality with her, stressing the

widely varying possibilities of attraction to persons of one's own sex on a physical and personality basis without having to accept that this means more than an incidental tendency of the total personality. She seemed more at ease and the next day (October 20) asked to discuss the two episodes occurring at the ages of 11 and 14 which she considered homosexual. She recognized that on both occasions she had felt lonely and had accepted the caresses of a girl as affection without responding with actual sexual sensations. After much assistance she discussed a friendship of years with a woman with homosexual tendencies, in whose presence she had once experienced sexual desire. This discussion did not lead to a disruption of the friendship but to a better understanding of the problem of homosexuality. Instead of an "either-or" attitude, she began to realize that homosexual tendencies are present in every one to a varying degree and may be stirred up and appear at certain periods of life or in certain situations. I kept a further study of homosexual possibilities in mind but wished to postpone the discussion until the patient had achieved more security. The panic features disappeared after this discussion (October 22).

This slight panic was not a fear of homosexuality itself but was due to a threat to her independence, which had to be based on self-assertion and trends which she considered masculine. The preceding discussions had seemed to indicate to her that she had to give up either independence and be a woman or, if she wished to preserve her independence, give up her desire to be a real woman.

Although she felt more secure after two days, considerable tension persisted. She expressed marked resentment that every one considered intelligence and vision male characteristics and weakness and dishonesty female traits. Her thoughts then turned to her heterosexual attractions, and on my advice she analyzed her two premarital sexual relationships. Her first lover had been attractive as a personality only; the second attraction was purely physical. She again (November 1) expressed marked resentment of the advised sexual abstinence. She could not bear the thought of what she had missed if something should happen to her husband. It was an interference with her desires which she could not tolerate, a restriction of her freedom. If treatment was going to lead to this, life would be unbearable. All these factors were carefully studied. Her "freedom," by which she meant an uncontrolled and undisciplined life, had been her great treasure. After these discussions (about November 6) fears of being unable to control herself and of jumping out of the window appeared. A study of the need for restrictions in one's conduct did not lead far, as she excused her lack of restraint by her unbounded vitality. She was unable to find what to her would be a constructive outlet for her vitality except in charity work. Love for children and bringing them up were prevented by her fear of having children. Social contacts were unsatisfactory because she had been told that she was popular only on account of her wealth. Her only understanding friend (her first lover) had to be given up. Her relationship with her friends was guided by her desire for dominance and frequently resulted in her submission. The same attitude existed toward her husband. This group reaction had been present since childhood. Fears increased a few days later when she discussed her "greediness" for power over men. At this time her fears when on trains had completely disappeared. I had brought up these various topics to produce a better relationship to the group and to correct her feeling of loneliness. Her resentment of the treatment and her homesickness again increased. A renewed discussion of her attitude toward physicians brought out that she hated and admired physicians because she believed that they held power over life and death. She said spontaneously that this same attitude had been marked toward her father since childhood. Fearfulness and suspiciousness

became more marked (November 13 to 19). People might find out how she felt. I discussed with her the sensitiveness about the impression she made on others and again returned to the topic of self-reliance based on understanding and control of oneself. She discussed in this connection her strong desire for revenge on any one who interfered with her "freedom"; she remembered that this trait had been marked since preschool age. She was afraid of having children because it would restrict her unless she dominated them absolutely and because they might inherit her unhappy make-up. On this occasion she mentioned a cousin who suffered from a dementing type of schizophrenia. Disorder in concentration appeared again, and with it the memory that her cousin's illness had started in the same way. For two days (November 21 to 23) the patient was in a definite panic. The thought of insanity was unbearable—it would mean loss of freedom—some one would be put in charge of her.

These symptoms indicated the possibility of the development of a psychotic reaction. From the beginning I had tried to increase her security by laying the foundation for better adjustment to the group and for self-reliance and a healthier relation to the physician and the treatment. During this period (November 21 to 26) free association was used less, and more time was devoted to constructive review. This was important because the patient showed an inclination to the development of increasingly destructive self-analysis. Discussions were frequently directed to problems of minor importance (e. g., occurrences of the past twenty-four hours which helped to illustrate her reaction tendencies, including variations in mood), but without refusal to discuss constructively her present fears and complaints and to offer reassuring formulations. Thus, I was able to produce a therapeutic rest without interrupting the planned course. (In some cases complete cessation of the analysis for a few days or longer is indicated. One should then formulate this interruption to the patient constructively, first determining, however, whether one's own concept of the case needs reformulation.)

The discussion from November 23 to 26 turned to a study of the patient's assets and their utilization (intellectual ability, persistence in pursuing a goal, energy and pleasure in activity, social assets, sympathy for suffering and enjoyment of beauty in art and nature). The fears subsided on November 24, and tension began to decrease. On November 27 discussion of her cousin's illness, for which she now seemed ready, gave her a better understanding of her tendency to jealousy and suspiciousness. Both traits were considered to be due to the envy of her brothers' brilliant performances intellectually and in sports when they were children and in early adolescence, her brothers' tendency to make her feel inadequate, frequently in an unfair way, and her fear of losing anything which she possessed. In adolescence a belief that inherited wealth and social position are not justified and that others were therefore prejudiced against her began to interfere with social ease. This material was also obtained by free association, as the patient was unable to talk freely after the panic had subsided. The indirect approach here seemed to lead to a personality study which would have taken much longer by a direct method.

From this time, the treatment progressed steadily during two months (December and January) without further insecurity, panic reactions or suspiciousness. Tension decreased rapidly, and during the last five weeks the patient was entirely free from symptoms. During this treatment the following outstanding dynamic factors were found, many details of which I shall omit to save space:

Discussion of the patient's premarital sexual life revealed that her first lover was married, whom she took partly for spite, to hurt his wife and to assert her rights in sexual freedom, and partly because she loved him as a personality. He

was not attractive physically. Her second lover attracted her entirely on a physical basis. She despised him as a personality. Her father had formed her ideal of men, and her two lovers had represented him either physically or intellectually. Her husband was a unification of both. She had been frigid with him, however, because her exaggerated and misguided self-assertion did not allow her the surrender which is necessary to achieve orgasm. Of secondary importance in her problem of frigidity was her whole sexual development. She had begun to show her first marked interest in sex (at the age of 6 or 7) by watching the sexual activities of animals and noticing their sexual organs. At that time she had a marked reaction of uneasiness to being close to her grandfather, because she had felt his genitalia. Owing to the birth of a younger brother she also became aware of childbirth at this time. Sexual play with dolls increased. At the age of 12 she showed a reaction of uneasiness to seeing her father naked and shrank afterward from being close to him physically. There is no proof that she was envious of the male genitalia at that time, but later when intercourse took place she resented that the man has to assume an active and aggressive rôle sexually. The dominant influence of the father in her later sexual life (through ethical standards) and the transient homosexual episodes have already been mentioned. (This understanding was reached by the middle of January. Sexual relationship with the husband was then resumed during week-end visits, and the patient obtained orgasm and full relaxation.)

It is of interest that the first "homosexual attachment" (at the age of 11) offered her the affection which she had been denied from her mother as a small child (before the age of 4 years). Her attitude to her mother had been one of admiration of her beauty and social attractiveness, with a desire to be like her and resentment of her neglect. At the time of treatment both the tendencies were still present, although not marked. In her second "homosexual attachment" (at the age of 14) similar factors, as well as admiration in the sense of hero worship, were important. The second girl and also her friend of recent years (mentioned on page 478) showed marked masculine behavior. The masculine ideal had become more dominant in her. These homosexual tendencies show clearly the influence of the mother (affection and admiration of feminine beauty) and then that of the father (admiration of his personality trends and physical fitness). A strong desire for promiscuity was based on the maladjustment in the sexual life and general personality and on her curiosity and desire to get out of life as much as possible and not on the influence of so-called latent homosexual factors.

In adolescence the father had warned her against drinking and flirting, which might lead to loss of virginity. The experiences in the first intercourse were therefore greatly disturbing, and she was still unable to clarify and broaden her own concept of virginity. Sexual relations did not become fully acceptable, ethically, until the end of the treatment. The father had also held up to her a high ideal of honesty, which she had not carried out in her sexual life.

The whole treatment was taken as chastisement and self-denial as they had been taught by her father. (The patient began to talk about this on December 10.) Her belief that it is more "honorable to bear one's guilt than to confess it" frequently made treatment difficult. Her phobias were death wishes for her father (1922)—having inflicted pain on some one puts one under obligation, which is canceled by inflicting pain on oneself; her father had worried because of her suspected love affair and her undisciplined and spite behavior. Her brother, who had succeeded her father in his position in life, had also taken her father's place in the family and in her own life. This brother's increasing addiction to the use of alcohol had distressed her greatly, and his sudden death (in 1925) had come as

a relief, although it caused a guilt reaction and also took away the person whom she admired and depended on in times of insecurity. During the first few days after the funeral she became greatly touched by her future husband's sympathetic help and began to admire and love him.

Her concept of freedom was life without outside control. She reacted with resentment and frequently with spite and revenge when she noticed infringement on her liberty. She wanted to get everything possible out of life. Death seemed terrible because it was a constant threat to life. The finality and unchangeability of death frightened her.

Her inability to bend and her tendency to react with self-assertion have been mentioned in connection with her sexual life and her attitude to her father and husband. There was, however, in general a constant struggle of devotion and admiration with defensive self-assertion and fear of being forced to give in. This affected her social attitude. She put people on the defensive, frightening them through her self-assertion or through her emphatic discussions. These tendencies and her inability to share with others because of reserve and mistrust had made her lonely in childhood and more so in later life. She hurt the feelings of other persons because she did not pay enough attention to their pride and type of sensitiveness. When she was aware of having caused such reactions in others she showed resentment because she herself felt hurt. The understanding of the sensitiveness of her friends gave her an understanding of her own sensitiveness.

The patient's pronounced narcissistic tendencies with regard to her body, which had been obvious since puberty in masturbation and sexual fancies, and her need for admiration of her intelligence and of her family's cultural background were undermined and disturbed by the feeling that she was liked chiefly because of her wealth and social position. In adolescence she had turned to socialism and had taken training as a nurse to assert herself. During the treatment she recognized that she had a definite resentment toward her father, as she knew he would not have approved of her sexual life, and marked feelings of guilt. Her charities were frequently based not on sympathy but on a need to satisfy her feeling of guilt because of her inherited money and to receive gratitude. She disliked fashionable people because she considered them hypocrites who have no loyalty in sexual life and easily indulge in drinking, eating and luxuries. Only at the end of the treatment did she recognize the lack of loyalty in her own past sexual life. With an increasing understanding of the significance of imaginations, she also saw how disloyal she was to her husband in indulging in promiscuity, even in imagination. She saw that physical and personality factors cannot be separated and that a dissociated sexual life cannot lead to satisfaction. The indulgence which she criticized in members of her set was practiced by herself in imagination.

Her self-reliance had been built on her exaggerated self-assertion, which had been shaken during the treatment. She then found strength and poise within herself (at the beginning of January). She realized that she was able to offer much to her husband, her friends and society in general.

She became able to accept a certain submission of the personality in married life and developed a concept of family formation in which sexual activities are merely one of many important features. She hesitated to have children because she wanted to try herself out first to make sure that she could be a satisfactory mother. This hesitancy to accept the full responsibility of children was not due to "neurotic" factors but was the expression of a conscientious and cautious personality. There was, however, still fear of pain and of the dangers of childbirth. Her extreme timidity and fear of pain had now changed to reactions of normal intensity. She was able to accept that constitutionally she was not fear-

less and that she was different from her father and oldest brother, who had both been fearless and, although usually guided by foresight, had been inclined to take hazardous chances.

At the end of the treatment the patient felt at ease and secure in herself. She has since been leading an active life. She has a normal sexual life, takes her own place in her family and is bringing up her children in a healthy way. Self-assertion is still rather pronounced and occasionally causes difficulties, which, however, she handles well.

This case illustrates the occurrence of two panic outbursts, with fear, insecurity, suspicions and difficulties in concentration, similar to those in schizophrenia, as incidents to the treatment. Through stress on synthesis to reestablish security, a more serious degree of panic was prevented. The first outburst might be designated as a homosexual panic; the second, as panic due to fear of mental disease. The analysis of the factors involved, however, shows how superficial and general such a situational concept is. The constitutional factors, need for self-assertion and threats to the patient's independence in the first panic and threats to her freedom in the second were of fundamental importance. Homosexuality and mental disease in a hereditarily predisposed family were considered to be dangers but not such that they could not be dealt with constructively under ordinary circumstances. At this phase the treatment had undermined her exaggerated self-assertion and self-dependence and brought doubt into many of her well established conceptions, confronting her frankly with shortcomings and evasive actions in the past and present.

The study led further in the second case than in the first, owing to the material involved and not to the method used. In more suitable cases the direct method gives the same results as the indirect approach. The choice of method is indicated by the material and by the physician's interests and talents.

DYNAMIC FACTORS AND CONSTITUTIONAL MAKE-UP

These two cases offer material with which the method of distributive study and synthesis has been used for investigation and treatment. The method and results can therefore be reviewed in concrete terms. It is obvious that much attention is directed to clear description and delimitation. The subjective aspect is always carefully investigated. On the other hand, instead of the investigation remaining on the level of static description (as, for example, in phenomenology) a genetic-dynamic procedure is used. All the possible dynamic factors are scrutinized, and the patient is led to find interrelations and developments. Concrete examples of various situations are studied as experiments.

Security can be disturbed along various lines, according to the individual needs, and different types of situational panics will result. An

understanding of the situational factors is usually readily obtained and will therefore not need further discussion, although this knowledge is of considerable importance for the handling and prevention of the individual panic reaction. Of greater interest for a genetic-dynamic understanding is the investigation of the insecurities which have developed—to what extent they are constitutionally determined, forming predispositions which are precipitated into panic reactions by specific life experiences and situations, and to what extent they are due to features and dynamic factors which have developed wholly or partly during life. The significance of life experiences in the development of constitutional features and the extent to which modification is possible are of leading concern.

Much effort is exerted to determine the constitutional make-up. This is essential for any objective work. One has to know with what material one deals in order to understand the reaction. The term constitutional make-up is used in the sense of that which is inherited or acquired so early in life as to have become ingrained and difficult to modify.

The danger always exists that too much will be covered by the term constitutional and that through vagueness and generalization it will become a formidable handicap to future investigations. Any frank study of personality development will bring out the influence of life factors on the formation of personality. The acceptance of the importance of constitutional fixations does not deny the importance of formative factors and does not exclude the possibility of modification. Psychobiologic psychiatry must consider both to be guided by what is obtained in the individual case. (It is necessary to realize that the facts are obtained in retrospect, and one should not consider them to be objective data unless they can be checked by studies made at the time of the happening, i. e., in childhood and adolescence, and in special cases by observing the patient through the formative periods of personality development.)

An important contribution to the understanding of what is constitutional is the study of heredity. It is not sufficient to dwell merely on the recessive hereditary factors in case 2 and speculate on the question of schizophrenic influences. The self-assertion and urge for independence, shyness and social need, intellectual curiosity and thirst for knowledge and caution combined with fearlessness, especially with regard to physical pain, were outstanding features of the patient's father, of two of her brothers and of her paternal grandfather. The tendency to anticipation, timidity and fear of pain were marked not only in her mother but in more distant members of her family on both the maternal and the paternal side. These trends were no doubt inherited, but to

what extent environmental influences and formation of ideas furthered their development is impossible to state.

Through the study of panic reactions I arrived at the conclusion that definite personality features are always found and that this constitutional predisposition is essential for the development of a panic reaction. The significant features are: the tendency to live up to ideals, which may be ethical, social or financial, high concepts of duty and responsibility and bodily and intellectual condition and appearance. These tendencies develop during life into perfectionistic and set attitudes. Inability to adjust oneself to past experiences and to digest mistakes is coupled with fear of being unable to manage a similar situation in the future and generally a tendency to anticipate difficulties and thus undermine ease and self-confidence. Being reserved and unable to share readily with others, such persons bottle up unpleasant experiences and expectations within themselves. Their high regard for right and wrong does not allow them to make concessions readily. If these characteristics occur in a generally loosely organized personality (e. g., immature or otherwise psychopathic personalities), fear and panic reactions occur relatively easily. These constitutionally predisposed persons feel at ease only in states of full security. In well organized persons prolonged and marked insecurity is necessary to produce continuous tension and outbursts of panic.

The cases described demonstrate these constitutional features and temporary or lasting fixations and rigidities and the influence of life experiences on their development. In both patients the urge for self-dependence, independence and self-assertion was marked. These tendencies had been fostered in the first case by the guiding ideals of the father and brother and by the environment of childhood. This patient, in his desire to reach his father's standard, had made success his goal. In the second case there was an exaggerated masculine orientation in the sense of striving for features which the patient attributed to her male ideas and not in a sexual sense. This masculine orientation had been an outstanding formative factor in her personality development and had resulted in a drive for power. In both cases these features were greatly influenced by a tendency to be aware of the impression made on others. This developed into a need to be admired, especially with regard to the body, general appearance and behavior and intellectual performance. Both the patients had a constitutional need for close contact with others, coupled with reserve and shyness. In the first case loneliness developed late, and in the second, early, owing to specific life factors. Loneliness was not a constitutional feature in either case. Reserve and shyness were prominent features in the second case. They were of a far less important degree constitutionally, as the inves-

tigations and therapeutic success proved. Intellectual curiosity and thirst for knowledge appeared early as definite characteristics but were also further stimulated by the life setting and reached exaggerated degrees in adolescene in both cases. Cautiousness, another constitutional trend which was necessarily increased and directed along specific lines through manifold formative influences, in case 2 developed early into suspiciousness. This easily happens in a person who has the other features mentioned. Suspiciousness was not a constitutional trend in either case, and the make-up was different in this respect from the paranoic constitution. Every person has a more or less definite constitutional attitude toward the future, which if marked may express itself as anticipation (in both cases this has been shown since early childhood, in pleasant and unpleasant expectations). This tendency is readily fostered by life factors, especially if it occurs, as in case 2, with features of timidity and fear of pain. High standards and ideals and their specific direction are due to a combination of constitutional tendencies and formative influences and exert a great effect on all other features. Loyalty plays a rôle. Such tendencies often reach an extreme degree as perfectionism. Conscience and feelings of guilt are closely related to this. These features are important in connection with one's constitutional attitude to the past, which in these persons is characterized by inability to forget and a fear of the danger of repetition of unbearable situations. The study of greediness has not led far enough in either case to determine the constitutional basis. It may be entirely a secondary feature. The sexual orientation in case 2 is fairly clear as far as tendencies to homosexuality and promiscuity are concerned. The father and, to a less extent, the mother, the family setting and early life experiences were important. They merely influenced the constitutional sexual features, however, in the sense of orientation and did not form them. It should also be remembered that the first two episodes with girls were primarily due to a need for affection and to hero worship and that sexual factors entered only in the last episode. The definite narcissistic tendency can be understood only if the influence of all the other personality features, constitutional and acquired, is considered. The first case offered less material for an understanding of the sexual life than the second.

A critical review of the constitutional make-up has to be guided by the concept of the total personality. All the personality factors are interrelated, and new features arise from the integration and also from the lack of integration. The constitutional material develops differently, owing to manifold life influences during the period of growth, and can be understood only by considering the whole personality.

For the determination and evaluation of dynamic and constitutional factors, all possible interrelations have to be considered. This forces one to distribute one's inquiry along many lines, investigating psychogenic and nonmental (somatic) factors and part functions (of special organs) as well as the total personality. The study of the past is essential for the historical setting and for an understanding of the constitutional make-up and the personality development. The personality at the time of the study, all the situational factors and the attitude to the future have to be included in the investigation.

SUMMARY

The method of distributive analysis and synthesis is presented, and the actual procedure and the results obtained are illustrated in two cases of panic reactions. Clear description and concreteness have to be combined with a genetic-dynamic investigation. Situational factors receive attention, but the main effort is directed to the determination and understanding of dynamic factors and constitutional make-up. The exclusive evaluation of specific factors and reactions and their application as generalized laws and mechanisms are avoided. Instead of a dogmatic attitude a pluralistic interest guided by facts is urged.

THE MARCUS GUNN PHENOMENON

REPORT OF A CASE WITH SUGGESTIONS AS TO RELIEF

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In 1883 Marcus Gunn described the associated movement of the lower jaw and the eyelid which bears his name. Since that time others have commented on the same strange phenomenon, for which an explanation is still lacking. As cases of "jaw-winking" are rare and because the case to be described is the first in which a successful method for the relief of this curious embarrassing associated movement has been suggested, it is reported.

REPORT OF CASE

N. R., a man aged 21, was admitted to the Graduate Hospital on April 2, 1934, having been referred by Dr. Charles A. Young, Roanoke, Va. His chief complaint was involuntary elevation of the right upper eyelid on movement of the lower jaw to the left. The movements had been present since birth and were noticed when the patient first took the breast or a bottle. As far as his mother knew, she was entirely well during pregnancy and suffered no injuries. None of the family suffered from a nervous tic, epilepsy or headache. The mother and father were not related before marriage. Delivery was entirely normal. The boy cut his teeth, walked and talked at the proper time. Except for the usual diseases of childhood, he had no severe illnesses. His education progressed satisfactorily, although for financial reasons he did not go through college.

The curious associated movements of the right eyelid and jaw occurred spontaneously. During ordinary conversation they did not take place, but when the patient moved the jaws while eating the eyelid flew up, attracting the amused attention of those about him. This made him self-conscious and uncomfortable. Swallowing liquids was not accompanied by any movement of the right eyelid. Movement of the lower jaw to the left was necessary to produce the abrupt elevation of the right eyelid. The patient stated that the right eyelid opened more widely during the associated movement when he was tired or nervous.

Neurologic Examination.—This gave entirely negative results except for the condition of the right eye and the associated movement of the jaw and the right upper lid. The following description is a digest of the results of the examinations made by Dr. B. J. Alpers, Dr. E. B. Spaeth and the author.

There was no sensory change at any point in the face and there was no flushing, sweating or lacrimation. The left eye was normal in all details. All facial movements were normal. With the face at rest there was a moderate degree of ptosis of the right eyelid, the lid resting at a level between 2 and 3 mm. lower than the left lid. The right eyebrow was slightly higher than the left, possibly owing to an added effort on the part of the right frontalis muscle to raise the right eye-

Read at the Sixty-Third Annual Meeting of the American Neurological Association, Montreal, Canada, June 5, 1935.

lid. While the right eyelid could not be raised voluntarily quite as far as the left, we could not see that the right frontalis muscle took a particular part in the elevation of the right upper lid. Certainly the right eyebrow was not elevated synchronously with upward movement of the right upper eyelid. Corneal reflexes were prompt and active on both sides. Both pupils were round and centrally located. At times the two pupils were equal in size and somewhat dilated, but for the most part the right pupil was slightly smaller than the left. There was enophthalmos of the right eye of 1 mm. as compared with none of the left. Stimulation with bright light produced an equal contraction of the pupil on the two sides. In accommodation convergence the right pupil seemed to contract a little less vigorously than the left. Dissociation of movements of the eyeball was present. On looking to the right, the right eye looked straight ahead when the left was at the inner canthus. From this point the right eye moved alone to the outer canthus. This suggested interference with the normal movements of the right eye to the right. The other conjugate movements of the eyes seemed to be entirely normal. No movement of the eyelid accompanied any movement of the eyeballs in any direction. A ciliospinal reflex did not exist in the right eye, but it was active in the left eye. The fundi and visual fields were normal in both eyes.

Bilateral contraction of the masseter and temporal muscles or thrusting the jaw forward or backward or to the right with the mouth open or closed caused no movement of either eyelid. No movement of the facial muscles produced a change in the position of the right eyelid. Movement of the jaw to the left with the mouth open or closed, whether the act was performed rapidly or slowly, was promptly followed by an abrupt elevation of the right eyelid so that at least 3 mm. of the sclera above the eyeball was visible (fig. 1). The slightest voluntary movement of the lower jaw to the left caused the right eyelid to quiver upward, but the greatest increase in its elevation appeared only when the jaw was swung as far as possible to the left. The upward movement on the part of the right eyelid on deviation of the jaw to the left was slightly increased when the patient looked down. No other movement of either eyeball or of the head carried out simultaneously with deviation of the jaw to the left had the effect of increasing the elevation of the right eyelid. Passive movement of the jaw to the left produced no movement in the right eyelid until extreme lateral deviation was reached, when the eyelid suddenly flicked upward. No movement of the tongue or larynx had any effect on the eyelid.

Reactions to Drugs.—A 4 per cent solution of cocaine instilled in each eye produced a greater dilatation on the left side than on the right and reduced slightly the ptosis of the right lid. A 10 per cent solution of cocaine instilled into the right eye alone equalized the dilatation of the pupils. Homatropine hydrochloride 1 per cent instilled into the eyes caused wide and equal dilatation of both pupils without increasing the ptosis. Most striking was the fact that following the instillation of homatropine hydrochloride movements of the jaw to the left did not result in elevation of the lid. This was my observation, and I am certain of it because I was prepared to take photographs of the patient, but the presence of the homatropine prevented the spasm and made any attempt to photograph him useless.

It was apparent that elevation of the eyelid accompanied only movement of the lower jaw to the left. If this movement could be prevented it seemed probable that the spasm of the lid could be prevented. With the end in view of paralyzing the right motor fifth nerve, an injection of procaine hydrochloride was given into the third division. The usual anesthesia of the lower lip and tongue was pro-

duced, indicating a successful temporary block of the nerve. Following the injection the ptosis of the right eyelid increased, voluntary elevation of the lid was difficult and it could not be raised above the level of the pupil. When the patient opened his mouth the jaw deviated to the right. It was impossible for him to move the jaw to the left, and there was no spasm of the right eyelid with any movement of the face. There was no facial weakness other than the inability to raise the right eyelid. By the end of twenty-four hours the anesthesia

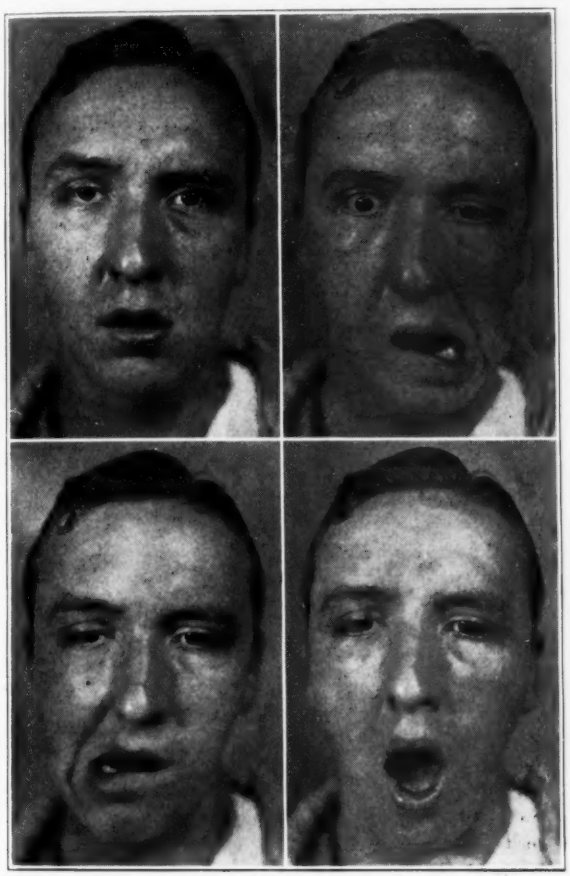

Fig. 1.—Photographs of the patient when he was admitted to the hospital. Note the slight ptosis of the right eyelid and the slight elevation of the right eyebrow with the face at rest. Only movement of the lower jaw to the left produced elevation of the right eyelid.

of the lower lip and tongue had disappeared. The ptosis of the eyelid had decreased to its original level, and the movement of the jaw to the left induced spasm of the lid on the right.

Therapy.—I suggested that since the result described had been produced with an injection of procaine hydrochloride into the third division of the right fifth nerve he could probably secure temporary relief from the spasm of the lid at

the cost of an increased ptosis of the right lid by the injection of alcohol into the third division on the right. Therefore, twenty-four hours after the injection of procaine hydrochloride, I made a successful injection of alcohol into the third division of the right fifth nerve, using 0.75 cc. of absolute alcohol. After the injection the usual anesthesia of the lower lip and tongue on the right was produced. However, there was no increase of the ptosis of the eyelid. Movements of the jaw to the right were free. The jaw deviated to the right when the mouth was opened, but the patient could still move the jaw to the left roughly ¼ inch (0.6 cm.), and the usual spasm of the lid accompanied this abortive movement. It seemed as though the alcohol had not diffused as far as the procaine hydrochloride and had not picked up all the fibers in the motor root of the nerve supplying the right pterygoid muscle. Following this rather surprising and disappointing result, surgical intervention by intracranial section of the motor root of the right fifth nerve was suggested.

After some discussion the patient accepted the suggestion. With the patient under ether and procaine hydrochloride anesthesia, the usual operation was carried out by the temporal approach. No difficulty was encountered until the sensory root was about to be exposed. It was then noted that the dura over the posterior edge of the ganglion was adherent and, when the subarachnoid space was entered, that the fibers of the sensory root were glued together tightly in one mass instead of floating as more or less individual fibers in the cerebrospinal fluid. Furthermore, in spite of careful search I was unable to distinguish between the sensory and the motor root. I was unwilling to sacrifice the sensory root, leaving the patient with complete and permanent anesthesia of the right side of the face. I therefore satisfied myself with cutting the third division, together with part of the ganglion that supplied the third division, trusting that by this maneuver I should cut the motor root as well. After complete hemostasis the wound was closed as usual.

After this procedure, the patient was seen at 5 p. m. on the day of operation. The ptosis of the eyelid was complete. Movement of the jaw to the left was impossible, and no spasm of the eyelid accompanied even passive movement of the jaw to the left. All ocular movements of the right eye at that time were normal. Unfortunately, just before examination and prior to operation in the morning, the patient had been given morphine, so that both pupils were somewhat contracted equally. At 2 a. m. the following day spasticity was present on the left side, and by 4 he was comatose. At 6 I reopened the wound and evacuated a large postoperative clot. After a stormy postoperative convalescence, the patient recovered. After evacuation of the clot, examination revealed that there was complete paralysis of the third nerve. Five days after the operation weakness of the right side of the face was noted; it continued to complete paralysis on the eighth day.

Course.—The patient was discharged on April 21. At that time the oculomotor and facial paralysis was complete. The paralysis of the fifth motor nerve and the anesthesia resulting from section of the third division of the fifth nerve were also complete.

The patient was seen on June 11. The facial paralysis was entirely gone, and the oculomotor paralysis had practically disappeared. The paralysis of the motor root of the fifth nerve and the anesthesia of the third division of the right fifth nerve were complete. There was a little more ptosis of the right eyelid than there had been when I first saw him. Furthermore, if he made a determined effort to move the jaw to the left and at the same time wrinkled up the left side of the face, the right eyelid was elevated, but with normal, natural movements of the jaw there was no movement of the eyelid. The patient was wearing dark glasses and still complained of some diplopia, but other than this he seemed to be

recovering satisfactorily. He was satisfied with his condition and felt that the result had been satisfactory.

A report on July 20 read as follows: The diplopia had practically disappeared. I could not find an abnormality in the ocular movements in any plane. Some of the sensation in the tongue was returning, and the anesthetic area in the face apparently was decreasing in size. The patient could not move the jaw to the left, and there was only an occasional twitch of the right eyelid when he attempted voluntarily to force the jaw to the left. Passive movements of the jaw to the left, even to extreme deviation, were not followed by movements of the right eyelid. He could eat and chew food without any recurrence of the old complaint. A slight ptosis of the right lid was present, roughly equal to that noted when he was admitted to the hospital. The right pupil was slightly larger than the left. Pupillary reactions were prompt, but the right pupil contracted to a slightly less degree than the left. A slight exophthalmos of the right eye could be determined (fig. 2).

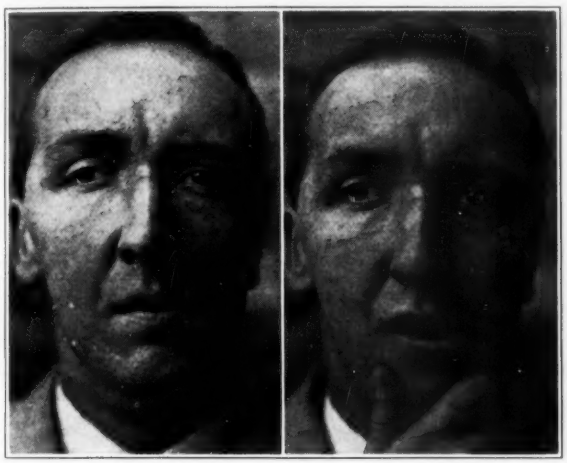

Fig. 2.—Photograph of the patient postoperatively, on June 4, 1934. Note the slight ptosis of right eyelid and the outward deviation of the right eye. When the patient forced his jaw to the left with his hand there was a slight elevation of the right eyelid to approximately normal position.

A letter received on April 26, 1935, stated that the patient had no diplopia, no interference with vision and no recurrence of the associated movements. The motor paralysis of the right side of the jaw in no way inconveniences him. He has gained 20 pounds (9.1 Kg.) and considers himself cured.

COMMENT

Before describing the different combinations and variations of associated movements which have been grouped under the Marcus Gunn phenomenon,[1] a review of Gunn's original case seems indicated.

1. Gunn, Marcus: Congenital Ptosis with Peculiar Associated Movements of the Affected Lid, Tr. Ophth. Soc. U. Kingdom **8**:283, 1883.

The patient was a girl, aged 17, in whom upward movement of the left upper eyelid had first been noted at the age of 5 weeks. When she looked straight forward, the left upper lid drooped so as to cover the upper fourth of the pupil. The fold of the lid did not run parallel to the free border, as in the normal condition, but met it at an acute angle near the inner canthus, thus giving an appearance of obliquity. The pupil of the left eye was smaller than that of the right; its reaction to light was good both alone and consentaneously, and it contracted well in accommodation. The upper lid followed the upward and downward movements of the globe, though it was not thus raised quite to the same extent as that on the right side. When the eyes were shut gently the left upper lid did not close quite so perfectly as the right. On being asked to raise her eyelids while looking straight forward, the patient endeavored to do so with the aid of the occipitofrontalis muscle and succeeded only in raising the left lid to a slight extent. When asked to do so without wrinkling her brows, she succeeded on the right side, but the left lid remained motionless.

On lateral movement of the patient's jaw to the right side (left external pterygoid muscle) the left upper lid was raised quickly and powerfully, and this position of the lid was maintained as long as the jaw was drawn to the right. The associated action of the lid was best marked when the jaw was moved while the patient was looking downward. The mouth could be opened gently without any movement of the lid, but when the lower jaw was projected forward there was immediately a jerking of the left eyelid upward. The same movement of the lid occurred in a slight degree occasionally when the patient was speaking, especially, as the patient had observed while looking in the mirror, in pronouncing words containing an s or x. If the jaw was moved to the right while the lids were closed, the contraction of the left levator palpebrae superioris muscle could be determined from the skin being thrown into folds over its insertion. During all such movements of the lid the pupil remained stationary, and there was no observable movement of the eye itself. The right upper lid was normal, and all excursions of both globes were well performed.

It will be noted that in this case the ptosis was congenital. A suggestion of the Claude Bernard-Horner syndrome was present, as shown by the ptosis and miosis. No mention of enophthalmos was made. Voluntary elevation of the ptosed lid was impossible without calling into play the frontalis muscle. The only movements of the jaw producing the associated action were to the right and forward. The movement of the left upper lid seemed accentuated when the patient looked downward.

In 1895 Sinclair [2] reviewed and reported cases of unusual associated movements of the eyelids records of which had appeared since Gunn's first communication in 1883. Thirty-three cases of "jaw-blinking" were reviewed and were noted to fall into four distinct groups. Sinclair stated that one condition was most frequently met with: There is unilateral congenital ptosis, varying in degree and with or without paresis of the superior rectus muscle. The drooping eyelid cannot be voluntarily raised, but it is vigorously raised when certain movements of the lower

2. Sinclair, W. W.: Abnormal Associated Movements of the Eyelids, Ophth. Rev. **14**:307, 1895.

jaw occur. The movement is strictly limited to the upper eyelid (levator muscle), and the patient cannot control it. It is best seen when the patient is looking down and moving the jaws, as during ordinary mastication of food. Sinclair's four variations of the condition were: (1) cases (thirteen) of unilateral congenital ptosis in which the drooping eyelid is raised both when the mouth is opened (digastric muscle ?) and also when the jaw is directed to the opposite side (external pterygoid muscle); (2) cases (thirteen) of unilateral congenital ptosis in which the drooping eyelid is raised when the jaw is depressed but is not raised on lateral movement of the jaw; (3) cases (three) of unilateral congenital ptosis in which the drooping eyelid is raised with lateral movement of the jaw (action of the external pterygoid muscle) but not with simple opening of the mouth (Gunn's original case falls into this group), and (4) cases (four) in which similar associated movements of one upper eyelid with movements of the lower jaw occur but in which there is no ptosis.

Since Pontico [3] and Villard [4] have reviewed the literature from 1883 to 1925, I shall merely refer to four cases overlooked by Villard and consider those described since his report. Damel and Natale [5] in 1918 described three cases in children. Tiscornia [6] reported a fourth case in a child. Adams,[7] Fromaget and Brun [8] and Dupuy-Dutemps [9] each reported a case in an adult. In all, one hundred cases of the Marcus Gunn phenomenon with different variations have been reported in the literature. The case which I report is the one hundred and first. Furthermore, in this case alone has any method of treatment been adopted and found effective.

A brief summary of the cases reported in the literature shows that this curious coordinated movement of the eyelid and jaw is not hereditary, although described in father and daughter and in cousins, nor does

3. Pontico, Paul: Des anomalies d'innervation de la paupière supérieure, Thèse de Paris, no. 373, 1910.

4. Villard, H.: Le phénomène de Marcus Gunn (synergie fonctionelle entre l'abaissement de la machoire et l'élévation de la paupière supérieure), Bull. et mém. Soc. franç. d'opht. **38**:725, 1925.

5. Damel, C. S., and Natale, A.: Movimientos asociados del Parpado superior y de la masticacion, Semana méd. **25**:41 (July 11) 1918.

6. Tiscornia, A.: Movimientos asociados del parpado superior y de la masticacion, Fenomeno de Gunn, Rev. Asoc. méd. argent. **35**:390 (July-Aug.) 1922.

7. Adams, C. J.: Associated Movement of Upper Lid and Jaw, Am. J. Ophth. **6**:401 (May) 1925.

8. Fromaget, C., and Brun, C.: Phénomène de Marcus Gunn compliqué, Bull. Soc. d'opht. de Paris, April 1926, p. 153.

9. Dupuy-Dutemps, L.: Ptosis congénital et phénomène de Marcus Gunn, Bull. Soc. d'opht. de Paris, March 1929, p. 136.

syphilis play a part in its occurrence. In ninety-three of the hundred reported cases the condition was congenital; in only seven was it acquired. When acquired, the condition may appear at any age (from 11 to 55) and may be due to a variety of causes, such as trauma and exposure to cold. Males are more frequently affected than females; the left eyelid is much more commonly implicated than the right. Complete absence of ptosis of both eyelids has been recorded only seven times, but bilateral ptosis has been noted in only three cases. Usually the ptosis was slight and incomplete, and in the majority of instances the ptosed eyelid could be voluntarily elevated. When upward movement of the eyelid is possible, the frontalis muscle frequently is called into action. While the motility of the ipsilateral eye is usually unaffected, paralysis of any or more, rarely all, of the ocular muscles has been observed. No one muscle or group of muscles seems to be singled out for concomitant paralysis. For the most part the pupils are normal and equal, but when inequality in size occurs it is usually the pupil of the affected side which is the smaller, as in my case. Pupillary and corneal reflexes are always present, and visual acuity is never seriously affected. Briefly, then, when the patient is observed with the face immobile little can be seen except a certain degree of ptosis of one eyelid. But when the patient moves the lower jaw a startling change takes place. The ptosed eyelid flicks upward, and the palpebral fissure promptly becomes much wider than its fellow. As in my case, chewing food is always accompanied by an upward twitch of the eyelid, which greatly embarrasses and annoys the patient, so that he becomes self-conscious and refuses to eat with strangers. Curiously, in most of the reported cases ordinary conversation or passive movements of the lower jaw did not provoke the associated movement of the eyelid.

Three movements of the jaw accompany mastication, up and down, from side to side and forward and backward. In the majority of cases reported, movement of the eyelid followed opening of the jaw in the midline or opening of the jaw in the midline succeeded by lateral movement. It is impossible to move the jaw from side to side without at least relaxing from contact the upper and lower teeth, for the teeth prevent it. In my patient, as the photographs show clearly, dropping of the lower jaw in the midline produced no movement. Only when the jaw was swung laterally to the left did the right upper eyelid jerk upward.

Dupuy-Dutemps,[9] in reporting a case of congenital ptosis of the right eyelid affected by opening the mouth or swinging the jaw to the left, attempted to show that only contraction of the homolateral external pterygoid muscle produces the elevation of the eyelid. In his case, when the mouth was opened in the midline, the right lid, which was relaxed sufficiently to cover two thirds of the cornea, was elevated only to the

normal position assumed by the unaffected lid. But when the jaw was moved forward or to the left, the right lid was raised much higher, disclosing the sclera above the cornea. Dupuy-Dutemps noted that putting a large cork between the teeth and having the patient bite on it, which brings the temporal and masseter but not the external pterygoid muscles into play, induced no movement of the right eyelid. Fromaget and Brun [8] reported an extraordinary case. The patient had complete congenital ptosis of the right eyelid, which could be relieved by opening the mouth in the midline and by movement of the jaw forward and backward or to either side. With the mouth closed, clenching the teeth tightly together elevated the right lid. But most amazing of all, when the subject closed the left eye or the eyelid was pulled down by the examiner, the ptosed right eyelid promptly opened. Closure of the left lid was necessary to produce the reaction, for covering the left eye with a patch, thus obscuring vision but not affecting the upper lid, did not cause the associated movement.

The Marcus Gunn phenomenon results, therefore, from opening the mouth in the midline plus a movement of the jaw to the opposite side away from the ptosed upper lid. Fromaget and Brun [8] and Algan [10] reported cases in which lateral movement of the jaw to either side caused elevation of the ptosed eyelid, but the case reported by Friedenwald [11] is the only one in which the movement of the eyelid was produced on lateral movement of the jaw to the same side, hence accompanying action of the contralateral external pterygoid muscle. In all other instances elevation of the ptosed eyelid accompanied contraction of the external pterygoid muscle on the same side.

Other associated movements by use of which the ptosed eyelid could be raised have been recorded, in which the muscles supplied by the seventh and ninth nerves or the motor nerves of the eye were called into play. In the case of Fromaget and Brun, closing the opposite eye resulted in elevation of the ptosed lid. Blok [12] reported a case in which puffing out the cheeks, as in whistling, elevated the ptosed lid, and Doré [13] reported a case in which swallowing and upward movement of the larynx caused slight elevation of the drooping lid. Movement

10. Algan, H.: Une observation de syndrome de Marcus Gunn, Rev. méd. de l'est **52**:293 (May 1) 1924.

11. Friedenwald, H.: On Movements of the Eyelids Associated with Movements of the Jaws and with Lateral Movements of the Eyeballs, Bull. Johns Hopkins Hosp. **7**:134 (July) 1896.

12. Blok, D. J.: Onwillekeurige medebeweging van een ptosisch ooglid by andere spierbewegingen, Nederl. tijdschr. v. geneesk. **27**:287, 1891.

13. Doré, A.: Mouvements involontaires de la paupière supérieure associés à ceux commandés par les autres nerfs craniens (maladie de Marcus Gunn), Clin. ophth. **21**:475, 1916.

of the eyeballs, as described by Blaschek,[14] can result in associated elevation of a ptosed eyelid.

What are the nerve pathways over which pass impulses causing the associated movement of eyelid and jaw? That is the most mysterious and fascinating part of the problem presented. Since no autopsy observations have been reported in any of the cases, every explanation offered is admittedly hypothetical. Obviously a connection must exist between the oculomotor nerve, supplying the levator palpebrae muscle, and the motor branch of the fifth nerve, sending impulses to the external pterygoid muscles. In other instances in which motor impulses over the seventh or the ninth nerve have produced movement of the eyelid, a connection between these nerves and the oculomotor nerve must be presumed. Shall one believe with Wilson [15] that there is an association of movements and not of muscles? If so, the cortex may be the point from which the synchronous action is initiated. Or is there a nuclear connection in the brain stem? This was the opinion put forward by the commission that examined the patient in Gunn's original case. Nuclear connections between the cranial nerves exist in the brain stem, as exemplified by Bell's phenomenon, recently analyzed by Slotopolsky.[16] The work of Mendel [17] and Tooth and Turner [18] and the clinical observations of Hughlings Jackson [19] suggest a nuclear connection between the facial and the oculomotor nerve. However, Harman [20] vehemently denied on morphologic and embryologic grounds the possibility of any such internuclear connection, since they are of different orders of nuclei and are on different planes. Villard,[4] Pontico [3] and Amat [21] discussed the possibility that the associated movements may in some way be mediated through the posterior longitudinal bundle. Last, the suggestion has been made that there may be peripheral connections between

14. Blaschek, A.: Ein Erklärungsversuch der paradoxen Mitbewegungen zwischen Lid und Auge, Ztschr. f. Augenh. **13**:750, 1905.

15. Wilson, S. A. K.: A Note on an Associated Movement of the Eyes and Ears in Man, Rev. Neurol. & Psychiat. **6**:331, 1908.

16. Slotopolsky, E.: Bell's Phenomenon and Related Problems in Facial Paralysis, Ztschr. f. d. ges. Neurol. u. Psychiat. **125**:252, 1930.

17. Mendel, E.: Ueber den Ursprung des oberen (Augen) Facialis, Tr. Internat. M. Cong. **5**:311, 1887.

18. Tooth, H. H., and Turner, W. A.: Study of a Case of Bulbar Paralysis with Notes on the Origin of Certain Cranial Nerves, Brain **14**:473, 1891.

19. Jackson, Hughlings: Two Cases of Ophthalmoplegia Externa with Paresis of the Orbicularis Palpebrarum: Illustration of Mendel's Hypothesis, Lancet **2**:128, 1893.

20. Harman, N. Bishop: Innervation of the Orbicularis Palpebrarum Muscle, Tr. Ophth. Soc. U. Kingdom **23**:356, 1903; On the Origin of the Facial Nerve, Rev. Neurol. & Psychiat. **7**:88, 1909.

21. Amat, Marin: Sur le syndrome ou phénomène de Marcus Gunn, Ann. d'ocul. **156**:513, 1919.

the branches of the third and those of the fifth nerve, although, as Pontico stated, detailed anatomic studies have failed to produce convincing evidence of this.

Even if in the origin of congenital cases a pathway over which the synchronous movements are carried could be worked out, the acquired type of associated movement could not be explained. Any presumption that an anomalous connection between the oculomotor and the other cranial nerves lies dormant waiting for the proper conditions to stir it into activity seems difficult to believe.

From study of the case reported here, however, one or more facts may be culled. While no information can be gained that throws light on the central connections between the third and the fifth nerve, it seems that the nerve pathways producing the associated movement can be broken at either end. Homatropine hydrochloride instilled into the right eye dilated the pupil, did not increase the ptosis and stopped the associated movement. Three competent observers checked these facts, although unfortunately the test was made only on a single occasion. No explanation is offered for this observation. Homatropine hydrochloride acts on the myoneural junction between the oculomotor nerve endings and the dilator pupillae muscle. The drug could not possibly affect the smooth or striated muscle in the eyelid. The smooth muscle fibers of the eyelid are under sympathetic control, the voluntary muscle is supplied by the third nerve. Ordinarily, instillation of homatropine hydrochloride into the eye never causes ptosis of the upper lid, nor was the ptosis increased in this case. But the associated movement was abolished. This is the type of inexplicable reaction that might be passed over in discreet silence. However, since its occurrence was carefully recorded in the notes on the case, it is reported.

Cocaine instilled into both eyes caused less dilatation of the right pupil than of the left and did not affect either the ptosis or the associated movements. Cocaine acts by stimulation of the sympathetic endings in the dilator fibers of the pupil, causing their contraction and hence dilatation of the pupil. The reaction to cocaine therefore confirmed the slight weakening of sympathetic control of the right pupil suggested by the Bernard-Horner syndrome.

Block of the third division and the motor root of the right fifth nerve with procaine hydrochloride paralyzed these nerves, stopped the associated movement by preventing voluntary movement of the jaw to the left and increased the ptosis of the right eyelid, making its voluntary elevation more difficult. Similarly, an injection of alcohol produced the same degree of sensory loss in the cutaneous distribution of the third division of the right fifth nerve, but since the motor root was not completely paralyzed the associated movement was not obliterated. Nor was the ptosis increased. Unfortunately, after neither of the injections was

the state of the right pupil recorded. However, the increase of the ptosis following the injection of procaine hydrochloride into the third division of the fifth nerve might be accounted for by diffusion through the tissues. The internal carotid artery, of which the ophthalmic artery is a branch, runs near the point at which the third division was infiltrated. It is conceivable that the procaine reached this vessel and affected the sympathetic fibers running in its sheath. In this way sympathetic control of the eyelid and consequently ptosis could be produced. Following the injection of alcohol, since a much smaller amount of alcohol was used, little spread into the tissues occurred and the sympathetic fibers along the internal carotid artery were not affected. However, in my experience the third division of the fifth nerve has been blocked many times with procaine, and this is the only instance in which ptosis of the ipsilateral eyelid resulted.

Following intracranial section of the third division and the motor root of the fifth nerve, when the patient was observed six or eight hours after operation and before any symptoms of the unfortunate postoperative hemorrhage were present, the ptosis was again complete and the associated movement was suppressed. At this time it was distinctly stated that the pupils were contracted, presumably by morphine administered preoperatively, and that no weakness of any ocular movement was to be noted. How did an intracranial operation on the third division of the fifth nerve produce complete ptosis which could not be voluntarily overcome? It is true that the posterior two thirds of the ganglion and the sensory root had been exposed, for I had hoped to dissect out the motor root from the sensory root and cut it separately. This was an intracranial procedure. No chance existed of affecting the sympathetic fibers along the carotid artery. The first division of the right trigeminal nerve was not exposed. However, since facial paralysis developed a week later, the possibility remains that the great superficial petrosal nerve was avulsed and that traction on the facial nerve or hemorrhage into the facial canal resulted. Kuntz [22] showed parasympathetic fibers running in this nerve to the sphenopalatine ganglion, from which a connection apparently runs to the orbital contents. Kuntz also showed that the sympathetic fibers to the trigeminal nerve reach it central to the gasserian ganglion. If this is so, my operation may have severed this connection. However, it must be admitted that isolated ptosis of the ipsilateral eye without other evidence of oculomotor involvement has never been observed following section of the sensory root of the trigeminal nerve behind the ganglion or of any of its three branches in front of the ganglion, and it is certain that when the patient was first

22. Kuntz, Albert: The Autonomic Nervous System, Philadelphia, Lea & Febiger, 1929, p. 314.

seen after operation there was no ocular palsy nor was the pupil dilated, as would have been noted had the third nerve been involved.

Following the surgical procedure, after the facial and oculomotor paralysis had disappeared, the ptosis, slight enophthalmos and miosis on the right were no longer to be noted. It is interesting to speculate on the mechanism by which section of the third division and the motor root of the fifth nerve not only prevented the associated movement but also resulted in the disappearance of the mild sympathetic paresis.

Interpretation of the observations is difficult. To presume an imbalance between the sympathetic and the parasympathetic impulses in the causation of movement due to a contraction of voluntary muscles seems far-fetched. Yet to infer an abnormal connection between the third and the fifth cranial nerve is no more susceptible of proof. In any event, this case suggests that when this particular type of associated movement exists it can be obliterated by section of the motor supply to the appropriate pterygoid muscle.

SUMMARY

A case of the Marcus Gunn phenomenon is described in which movement of the lower jaw to the left caused synchronous elevation of the right upper eyelid.

Section of the motor supply to the right external pterygoid muscle prevented this movement of the jaw. In this way the associated elevation of the right eyelid, which occurred particularly during movements of mastication, was prevented.

DISCUSSION

DR. TRACY J. PUTNAM, Boston: Dr. Grant has performed a great service, first, in calling attention to this extraordinary phenomenon, which is generally forgotten, and, second, in showing that there is a dynamic practical surgical approach to the problem. I can easily imagine that an accumulation of results of surgical intervention will in the future go far toward elucidating the physiologic mechanism involved.

DR. F. H. LEVY, Philadelphia: The main interest in the case reported is undoubtedly in the successful surgical treatment. However, the exact clinical examination of the patient and the surgical approach seem to indicate some new aspects of the pathogenesis of the Marcus Gunn phenomenon.

The fact that mechanical suppression of the movement of the jaw by section of the third division of the fifth nerve prevented the phenomenon shows that it neither represents—like Bell's phenomenon—a cortical pattern nor was the result of an abnormal connection between the nuclei of the third and the fifth nerve. It even seems not to be dependent on the voluntary innervation of the jaw, as the phenomenon could be produced both before and after the operation by excessive passive movements. Hence, it follows that presumably the proprioceptive stimulus of the pterygoid muscles initiates the sign.

Two conditions seem indispensable to the appearance of the symptom. Examination has shown that only by one single nonsurgical method could the phenomenon be completely suppressed. This was by the application of homatropine hydrochloride. In other words, the good functioning of the parasympathetic innervation was indispensable to the abnormal raising of the eyelid. In coincidence with this experience, procaine hydrochloride, an antagonist of choline. the stimulator of the parasympathetic system, brought on an increase of ptosis. Finally, the literature indicates that a partial or complete paralysis of the levator palpebrae muscle was a second indispensable condition for the appearance of the Marcus Gunn phenomenon.

Thus, there are several indications that the Marcus Gunn phenomenon, as Cobb suggested, with regard to his recently reported case of lingual spasm, is to be placed under the group of the Vulpian-Heidenhain-Sherrington phenomena.

With this concept in mind, Dr. Groff and I started some preliminary experiments. The right oculomotor nerve was divided in cats. One week later we stimulated the parasympathetic nervous system by injecting acetylcholine into the carotid artery. Immediately afterward, following closure of the right eye for a very short period, the palpebral fissure opened maximally, the superior lid became everted and the mucosa became congested. Simultaneously, the whiskers of the right side moved distinctly. The result of this experiment seems to confirm the conception I have just stated.

Dr. J. G. Dusser de Barenne, New Haven, Conn.: I should like to ask Dr. Grant whether my impression from the first portion of the film is correct, that is, that when the jaw moved to the right, the eyelid closed partially.

Dr. Francis C. Grant, Philadelphia: I do not think so. It seemed to me that possibly when the patient moved his jaw to the left and the eyelid opened and then the jaw swung back, the drooping of the lid was just a return to the normal position. My associates and I measured carefully, and as far as we could tell there was no real closure of the lid with movement to the opposite side. The only movement that the patient made which affected the lid in any way was the movement of the jaw to the left.

Dr. Byron Stookey, New York: One of the theories for this syndrome has assumed an intra-axial, internuclear connection between the motor nucleus of the fifth nerve and the nucleus of the third nerve. Since Dr. Grant's operation did not in any way disturb this connection and yet abolishd the tic, it seems to me that one is perhaps warranted in concluding that the intra-axial, internuclear connection between these two motor nuclei does not play any rôle in the production of the syndrome.

Dr. Francis C. Grant, Philadelphia: With regard to Dr. Stookey's statement about an internuclear connection, I thought that this might exist until I saw the patient three weeks ago and found that, although he could still move his jaw to the left, the eyelid was not elevated when this movement occurred. That upset me, because I was not sure why that should occur. The most baffling part of the picture to me has been the fact that the movement of the jaw has returned but the movement of the eyelid does not accompany it.

SYNDROME OF THE POSTERIOR INFERIOR AND ANTERIOR INFERIOR CEREBELLAR ARTERIES AND THEIR BRANCHES

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In a previous communication on the syndrome of the superior cerebellar artery,[1] we called attention to the nature of cerebellar vascular occlusion and its rarity in contrast to cerebral vascular insults. At the time in only twenty such cases in our series of over three hundred was involvement of the cerebellar arteries revealed. In five of these cases the occlusion was confined to the posterior inferior cerebellar artery, and in one, to the anterior inferior cerebellar artery. Of all the cerebral and cerebellar vessels, anomalies are most commonly observed in the posterior inferior cerebellar artery. The variability of symptoms in cases of lesions of this artery is explainable on this basis. For a better understanding of the lesions and their anatomic relations, a brief description of the distribution of the inferior cerebellar vessels is given.

Posterior Inferior Cerebellar Artery.—This vessel arises from either the vertebral or the basilar artery. Commonly the vessel on one side originates from the vertebral artery and that on the other from the basilar (fig. 1). After its origin from one of these vessels the artery passes for a short distance obliquely backward or forms a vertical loop with its convexity directed dorsolaterally, running between the lobulus paraflocculari[2] and the superior and lateral parts of the medulla oblongata. From this point its course is toward the inferior part of the vermis, namely, the lobulus A vermalis and lobulus B vermalis, and it gives off branches to these structures and to the choroid plexus of the fourth ventricle. Occasionally, instead of passing obliquely backward after its origin, it forms a vertical loop with its

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Read at the Sixty-First Annual Meeting of the American Neurological Association, Montreal, Canada, June 3, 1935.

1. Davison, C.; Goodhart, S. P., and Savitsky, N.: The Syndrome of the Superior Cerebellar Artery and Its Branches, Arch. Neurol. & Psychiat. **33**:1143 (June) 1935.

2. The nomenclature of the cerebellar lobes in this presentation is that given in a previous communication.[1]

convexity toward the pons and then may pursue the course previously described. At about the point where it is hidden between the medulla oblongata and the cerebellum it divides into lateral and medial branches, the number of which may vary. Generally, there are one lateral and one medial branch, each of which further divides. The lateral branches supply the lower two thirds of the lobulus paramedianus and the major portion of the lobulus ansiformis crus 2. The medial branches supply part of the lobulus paraflocculari, the inferior surface of the vermis, especially the lobulus A vermalis and lobulus B vermalis, the medial part of the lobulus ansiformis crus 2 and the lateral parts of the medulla oblongata (fig. 1).

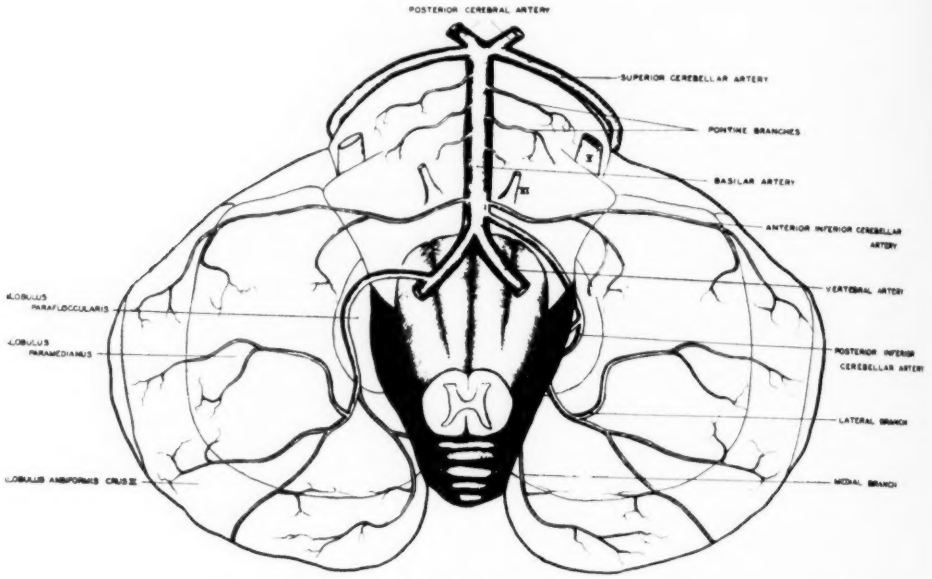

Fig. 1.—Diagram showing the vascular supply of the inferior and posterior surfaces of the cerebellum and the lateral part of the medulla oblongata by the anterior inferior and the posterior inferior cerebellar artery.

The area of the medulla oblongata supplied by the medial branch extends from about the middle of the hypoglossal nucleus below to the level of the entrance of the corpus restiforme into the cerebellum. In a transverse section of the medulla oblongata this area extends from the inferior olive to the corpus restiforme. The medial branch usually supplies the following structures of the medulla oblongata: part of the corpus restiforme; the reticular substance; the nucleus ambiguus; the tractus solitarius and its nucleus; the glossopharyngeal nerve; the nucleus and the descending root of the fifth nerve, and the spinothalamic, dorsal and ventral spinocerebellar and olivocerebellar tracts.

It may also supply the posterolateral surface of the inferior olive, the dorsal accessory olivary nucleus, the thalamo-olivary fibers, the vestibular nuclei and part of the medial lemniscus; the latter structure at this level normally receives its blood supply from the anterior spinal artery. Foix, Hillemand and Schalit [3] expressed the belief that this part of the medulla oblongata is supplied by the lateral artery of the medulla oblongata, a branch of the basilar or the vertebral artery. Ramsbottom and Stopford [4] have also shown that the branches of the posterior inferior cerebellar artery supplying the medulla oblongata may be replaced by direct branches from the vertebral artery. We were able to demonstrate this relation in some of our anatomic specimens, and it is our belief that the opinion of Foix, Hillemand and Schalit is based on the observation of this anomalous supply of the lateral parts of the medulla oblongata.

As will be shown, occlusion of the posterior inferior cerebellar artery generally destroys the lateral part of the medulla oblongata without involving the cerebellar structures. This selective destruction is due to the fact that the anastomosis of the medial branches of the posterior inferior cerebellar artery supplying the medulla oblongata is not as rich as the anastomosis of the lateral branches supplying the respective cerebellar lobes. The lateral vessels anastomose freely with branches of the superior cerebellar and anterior inferior cerebellar arteries. Another explanation for the selective destruction of the lateral part of the medulla oblongata without cerebellar involvement, given by Ramsbottom and Stopford [4] and Wallenberg,[5] is that the medial branches of the posterior inferior cerebellar artery supplying the medulla oblongata may be replaced by separate branches from the vertebral artery. Wallenberg [5] observed that frequently there is only one posterior inferior cerebellar artery and that the other is replaced by branches of the vertebral artery, which supplies the medulla oblongata, and by a large anterior inferior cerebellar artery which supplies the respective cerebellar structures.

It is claimed by most observers that the inferior olives are supplied by the lateral branches of the vertebral artery. In contrast to these observations, in some of the cases in this series involvement of the

3. Foix, C. L.; Hillemand, P., and Schalit, I.: Sur le syndrome latéral du bulbe supérieur, Rev. neurol. **32**:160, 1925.

4. Ramsbottom, A., and Stopford, J. S. B.: Occlusion of the Posterior Inferior Cerebellar Artery, Brit. M. J. **1**:364, 1924.

5. Wallenberg, A.: Acute Bulbäraffection (Embolie der Art. cerebellar post. inf. sinistr.), Arch. f. Psychiat. **27**:504, 1895; Anatomischer Befund in einem als "akute Bulbäraffection" beschriebenen Falle, ibid. **34**:923, 1901; Verschluss der Arteria cerebelli inferior posterior dextra, Deutsche Ztschr. f. Nervenh. **73**:189, 1922.

posterolateral parts of the inferior olive followed thrombosis of the posterior inferior cerebellar artery. In the case of Foix, Hillemand and Schalit, in which there was closure of the lateral artery of the medulla oblongata, the entire lateral part of the inferior olive was destroyed. Occasionally, in a case of occlusion of an anomalous posterior inferior cerebellar artery, the nuclei of the sixth and seventh nerves may be involved.

Anterior Inferior Cerebellar Artery.—This artery, called by the French anatomists the middle cerebellar artery, usually arises from the lower third of the basilar artery. When, as shown by Wallenberg,[5] one of the posterior inferior cerebellar arteries is absent, the anterior inferior cerebellar artery may arise from the vertebral artery and pass beneath the seventh and eighth nerves and the lobulus floccularis to reach the lower portions of the anterior and lateral surfaces of the cerebellum, where it gives off lateral branches to the upper parts of the lobulus paramedianus and lobulus ansiformis crus 2 (fig. 1). While it traverses the pons, a small branch supplies the fifth nerve and part of its nucleus. A branch which supplies part of the lobulus paraflocculari penetrates this area and reaches again the mesial surface of the cerebellum, where it supplies the lobulus C_1 vermalis and lobulus C_2 vermalis (presulcal and postsulcal) and the upper parts of the lobulus paramedianus and the lobulus ansiformis crus 2. The anterior inferior cerebellar artery forms a rich anastomosis with branches of the posterior inferior cerebellar and superior cerebellar arteries.

Middle Inferior Cerebellar Artery.—As described by Jakob,[6] this vessel is very inconstant and arises from the basilar artery, just above its origin. The artery passes laterally and supplies parts of the lobulus floccularis, lobulus paraflocculari and lobulus paramedianus. Occlusions of this vessel were not observed in this series.

METHOD OF PROCEDURE

Sections of the involved medulla oblongata and cerebellum, as well as sections above and below the lesions, were embedded in pyroxylin and stained by the myelin sheath and cresyl violet methods. Some blocks were cut in serial sections.

REPORT OF CASES

CASE 1.—*Classic syndrome of occlusion of the posterior inferior cerebellar artery, homolateral signs of cerebellar involvement, sensory disturbance over the face, tongue and palate, Horner's syndrome and paralysis of the palate on the right; contralateral sensory disturbances over the left side of the body; thrombosis*

6. Jakob, A.: Das Kleinhirn, in von Möllendorff, W.: Handbuch der mikroskopischen Anatomie des Menschen, Berlin, Julius Springer, 1928, vol. 4, pt. 1.

of the medial branch of the right posterior inferior cerebellar artery with destruction of the lateral part of the medulla oblongata from about the middle of the hypoglossal nucleus to the level at which the corpus restiforme enters the cerebellum; no involvement of the cerebellar lobes.

History.—M. S., a man aged 64, was admitted to the Montefiore Hospital on Oct. 29, 1929, with the history of a fall in 1914 followed immediately by transient paralysis of the right side of the body and face. Except that he dragged the right lower extremity, he remained well until February 1929, when he had a severe attack of vomiting, accompanied by dizziness, staggering gait and a tendency to fall backward. He was confined to bed for six weeks, when he experienced numbness of the left side of the body and the right side of the face and choking while eating. On Sept. 15, 1929, he found that he could not walk, but within three weeks there was improvement in gait. The patient had had hypertension for the past seventeen years.

Neurologic Examination.—The upper extremities were abducted; the right lower extremity dragged on walking. The finger-to-nose and finger-to-finger tests were fairly well performed, and there was no past pointing, ataxia, dysdiadokokinesis or Gordon Holmes phenomenon. On performance of the heel-to-knee test there was mild tremor of the right lower extremity when the heel was fixed on the knee, but the tremor disappeared when the heel was moved along the shin. There was slight weakness of the muscles of the left extremities. The deep reflexes on the right were slightly exaggerated; the abdominal reflexes were absent, and there was a questionable Babinski sign on the right. Sensory examination disclosed slight hypesthesia and marked hypalgesia on the left side of the body below the third cervical segment, hypalgesia between the third cervical segment and the sensory distribution of the fifth nerve on the left and mistakes in sense of position of the toes of the left foot. There were ptosis of the right lid and enophthalmos; the right pupil was slightly smaller than the left, but the pupils reacted to all stimuli. The extra-ocular movements were normal. There was diplopia on looking to the extreme left. There were hypesthesia, analgesia and thermanesthesia on the right side of the face over the distribution of the first and second divisions of the fifth nerve; hypesthesia of the right cornea; hypalgesia and hypothermesthesia of the mucous membranes of the nose, cheek and hard palate on the right side, and diminished sensation of taste on the anterior and posterior parts of the tongue on the right. The right side of the palate was paretic, and speech was hoarse, nasal and dysarthric. The tongue deviated to the right; there was no atrophy or fibrillation. Mental examination gave essentially negative results.

Course.—The patient died on Feb. 18, 1930, after bronchopneumonia.

Laboratory Data.—The blood pressure was 220 systolic and 150 diastolic. There was secondary anemia. All other laboratory data were normal.

Clinical and Anatomic Diagnosis.—The diagnosis was thrombosis of the right posterior inferior cerebellar artery.

Autopsy.—Gross Examination: The vessels at the base of the brain showed marked atheromatous changes. Old areas of softening were present in the right putamen and in the region of the right optic radiation. The right lateral surface of the medulla oblongata was softened; the area of softening extended from about the middle of the hypoglossal nucleus below to the level at which the corpus restiforme enters the cerebellum.

Microscopic Examination: Sections of the pons showed descending demyelinization of one pyramid. In sections of the medulla oblongata through the nuclei

of the fifth and seventh nerves there was partial demyelinization of the fibers of the right corpus restiforme, the olivocerebellar and thalamo-olivary tracts and the spinal root of the sensory fifth nerve. Sections of the medulla oblongata in the region of the nucleus of the tenth nerve disclosed an area of destruction extending from about the dorsal part of the right inferior olive to and including part of the right corpus restiforme and involving as well the nucleus ambiguus, the nucleus and descending root of the fifth nerve, the spinothalamic, direct and indirect cerebellar, olivocerebellar and thalamo-olivary tracts, the reticular substance, the glossopharyngeal nerve, the dorsal surface of the inferior olive and, to a slight degree, the medial lemniscus (fig. 2 *A*). In sections near the crossing of the lemnisci the area of softening was limited to the lateral surface of the medulla oblongata, implicating the structures already enumerated as well as the lateral part of the dorsal accessory olivary nucleus (fig. 2 *B*). The medial lemniscus was not involved at this level. In sections through the crossing of the pyramids only the nucleus and descending root of the fifth nerve were implicated (fig. 3); other structures, such as the dorsal cerebellar and spino-olivary tracts and the nucleus reticularis lateralis, stained poorly. The area of softening was filled with compound granular corpuscles, and the small vessels showed evidences of endarteritis. The ganglion cells belonging to the nuclear masses showed various pathologic changes. The medial branch of the posterior inferior cerebellar artery disclosed proliferation of the intima, calcification of the media and partial obliteration of the lumen.

Comment.—In this case the picture conformed clinically and pathologically to the classic syndrome of occlusion of the posterior inferior cerebellar artery. An unusual finding was the mistake in sense of position of the toes of the left foot. This was accounted for by the slight implication, at the level of the nucleus of the tenth nerve, of the medial lemniscus, which at this level is supplied by the anterior spinal artery. The absence of sensory disturbances between the third cervical segment and the sensory distribution of the fifth nerve was also reported by several observers. The cause of this phenomenon will be explained in the body of the paper. The sensory disturbances over the distribution of the glossopharyngeal nerve, though observed in cases of thrombosis of the posterior inferior cerebellar artery, are not common. The cerebellar lobes in this case were spared, as the partial occlusion was limited to the medial branch of the posterior inferior cerebellar artery. The softening of the medulla oblongata extended from about the middle of the hypoglossal nucleus to a level above that at which the corpus restiforme enters the cerebellum. In a cross-section of the medulla oblongata this area of destruction extended from the dorsal surface of the inferior olive to and including part of the corpus restiforme (fig. 2 *A* and *B*) and involved the following structures: the dorsal surface of the inferior olive; the thalamo-olivary, direct and indirect cerebellar, olivocerebellar and spinothalamic tracts; the nucleus and descending root of the fifth nerve; the nucleus ambiguus; part of the glossopharyngeal nerve; the tractus solitarius and its nucleus; the reticular substance; the corpus restiforme, and part of the nucleus olivarius accessorius dorsalis.

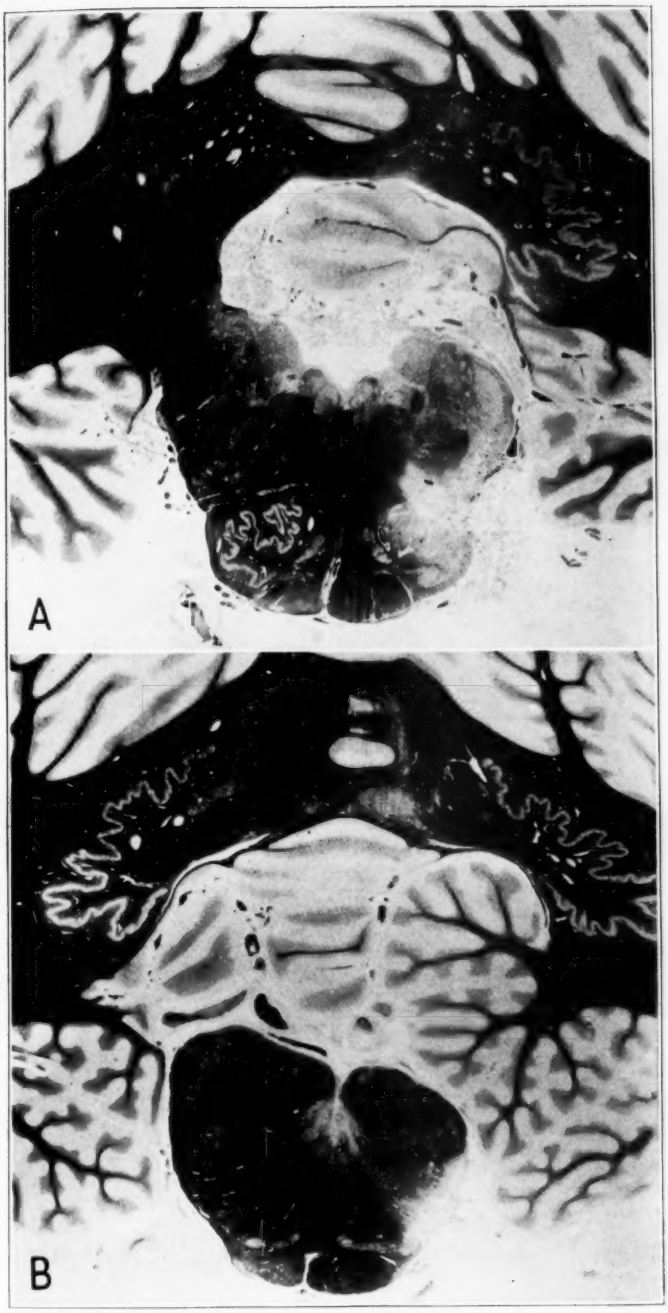

Fig. 2 (case 1).—*A* is a section of the medulla oblongata through the nuclei of the tenth nerve, showing an area of destruction extending from the dorsal part of the right inferior olive to and including part of the right corpus restiforme. The following structures are involved: the corpus restiforme; the nucleus ambiguus; the nucleus and descending root of the trigeminal nerve; the spinothalamic, direct and indirect cerebellar, olivocerebellar and thalamo-olivary tracts; the reticular substance, and the dorsal surface of the inferior olive. *B* is a section of the medulla oblongata near the crossing of the lemnisci, showing the area of destruction on the lateral surface, involving some of the structures enumerated in figure 2 *A* as well as the lateral part of the dorsal accessory olivary nucleus. The medial lemniscus was not involved at this level. Myelin sheath stain.

CASE 2.—*Classic syndrome of occlusion of the posterior inferior cerebellar artery; homolateral signs of cerebellar involvement; sensory disturbances of the face, Horner's syndrome, paresis of the palate and paralysis of the vocal cord on the left and sensory disturbances over the right side of the face and body; thrombosis of the left posterior inferior cerebellar artery with partial destruction of the lobulus paramedianus and lobulus ansiformis crus 2 and the dorsolateral surface of the medulla oblongata from about the middle of the nucleus of the hypoglossal nerve to a point where the corpus restiformis enters the cerebellum.*

History.—E. S., a man aged 60, who was admitted to the Montefiore Hospital on Oct. 22, 1930, suffered from an attack of dizziness, collapse and unconsciousness for twenty minutes in June 1930. He was confined to bed for two weeks, after which on attempting to walk he fell to the left. In August 1930, while

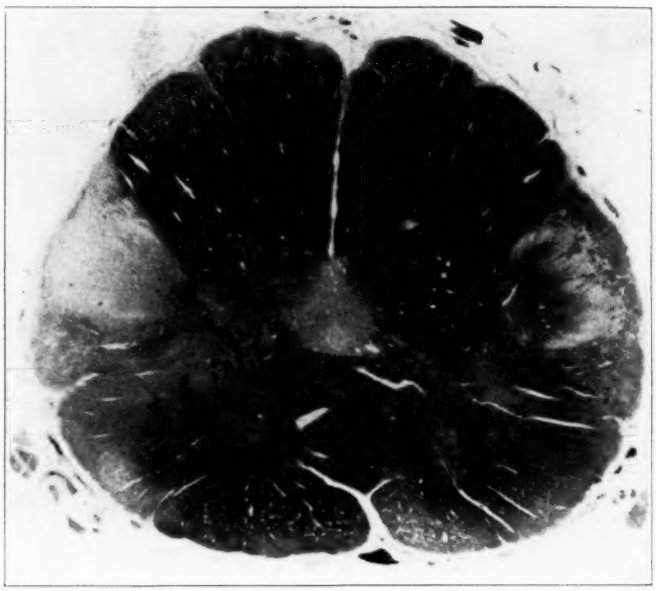

Fig. 3 (case 1).—Section of the medulla through the crossing of the pyramids, showing involvement of the nucleus and descending root of the fifth nerve, the dorsal cerebellar and spino-olivary tracts and the nucleus reticularis lateralis poorly stained. Myelin sheath stain.

shaving, he again became dizzy and complained of weakness, a tendency to fall to the left and hoarseness. The past, personal and family history was without significance.

Neurologic Examination.—The right shoulder was lower than the left; the patient walked with a broad base, swayed from side to side with the eyes open or shut and on turning about fell to the left. There was weakness of the muscles of the upper and lower extremities, but there were no pathologic reflexes. Hypesthesia, hypothermesthesia and hypalgesia were present over the right side of the body; the senses of position and vibration, stereognosis and two point discrimination were normal. The left palpebral fissure was narrower than the right; the

pupils were irregular, the left being smaller than the right, but both reacted to light and in accommodation. Nystagmus was present on looking to the left. There were hypalgesia and hypothermesthesia of the face and the mucous membranes on the left side and hypalgesia of the face on the right; sensation to touch was normal on both sides of the face, and the corneal reflex was impaired on the left. Hearing was better on the right. There were paresis of the left side of the uvula and palate and complete paralysis of the left vocal cord. Mental examination disclosed poor attention and defective memory for recent and, to a lesser degree, for remote events.

Course.—The patient lapsed into coma on March 6, 1931, and after this a bilateral Babinski sign was elicited. He died of hypostatic pneumonia on March 10, 1931.

Laboratory Data.—The blood pressure was 160 systolic and 106 diastolic. The spinal fluid on admission, except for a faint trace of albumin, was normal; during coma it was bloody. The Wassermann reaction of the blood and that of the spinal fluid were negative.

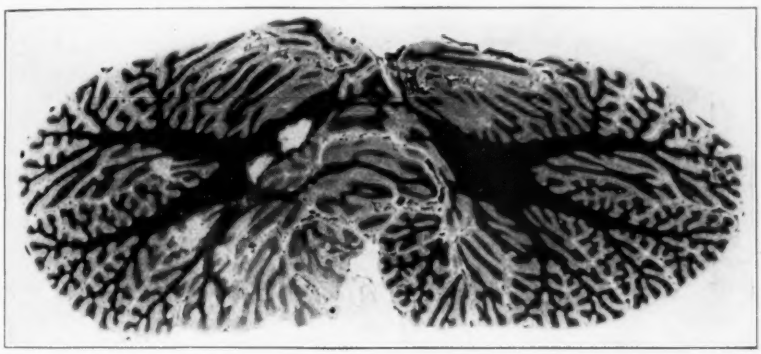

Fig. 4 (case 2).—Section of the cerebellum showing small areas of softening involving part of the gray and white matter of the lobulus paramedianus and lobulus ansiformis crus 2 on the left. Myelin sheath stain.

Clinical and Anatomic Diagnosis.—The diagnosis was thrombosis of the left posterior inferior cerebellar artery and multiple cerebral vascular insults.

Autopsy.—Gross Examination: All the cerebral vessels showed atherosclerotic plaques. The diameters of the basilar and left vertebral arteries were twice those of the normal vessels. The left posterior inferior cerebellar artery had its origin from the vertebral artery, and the right, from the basilar. The brain was cut horizontally. There was a recent hemorrhage in the area of distribution of the left lenticulostriate artery. Small areas of softening were present in the left island of Reil and the left cerebellar lobe.

Microscopic Examination: Sections of the cerebellum stained for myelin sheaths disclosed small areas of softening involving part of the gray and white matter of the left lobulus paramedianus and left lobulus ansiformis crus 2 (fig. 4).

In sections of the medulla oblongata through the nucleus of the tenth nerve, there was an area of destruction on the left lateral surface extending from the dorsal surface of the inferior olive to and including the corpus restiforme (fig. 5*A*). The following structures were destroyed: the corpus restiforme;

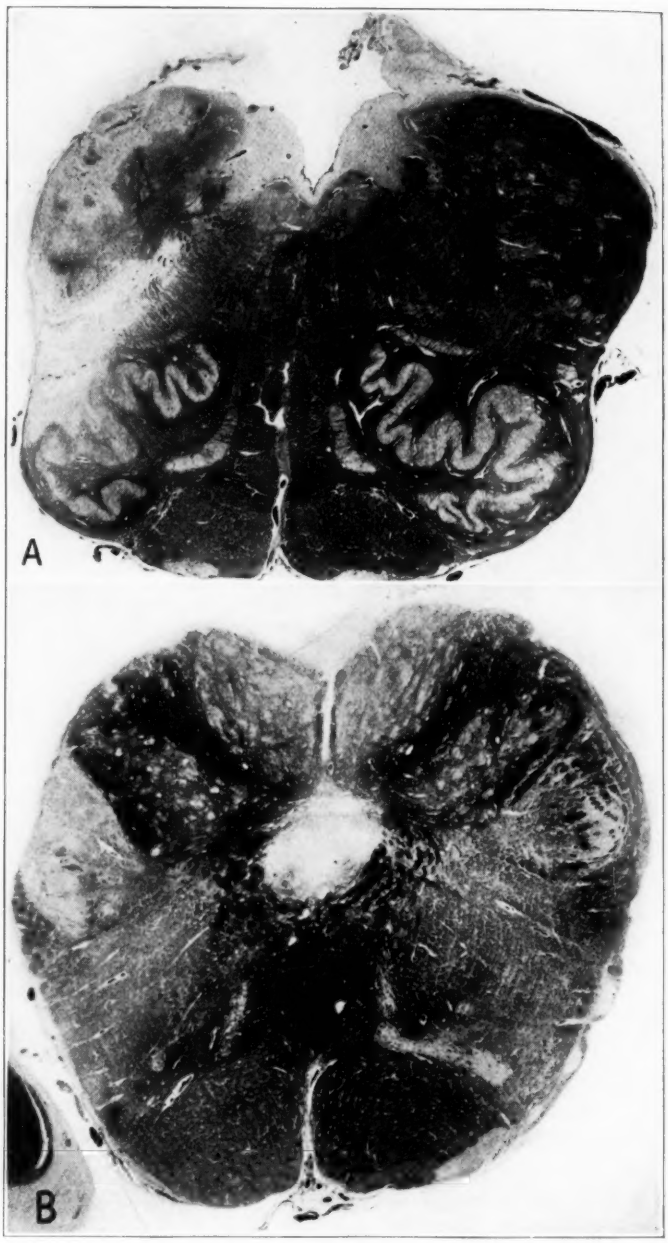

Fig. 5 (case 2).—*A* is a section of the medulla oblongata through the nuclei of the tenth nerve, showing an area of destruction of the left lateral surface extending from the dorsal surface of the inferior olive to and involving the corpus restiforme. The following structures were involved on the left: the corpus restiforme; the nucleus ambiguus; the tractus solitarius and its nucleus; the nucleus and descending root of the trigeminal nerve; the dorsolateral part of the inferior olive; the dorsal and ventral cerebellar, thalamo-olivary and spinothalamic tracts; part of the nucleus cuneatus, and the medial vestibular nucleus. *B* is a section of the medulla oblongata through the crossing of the lemnisci, showing involvement of the nucleus and descending root of the trigeminal nerve, the ventral and dorsal cerebellar tracts and part of the internal arcuate fibers and the lateral reticular nucleus. Myelin sheath stain.

the nucleus ambiguus; the tractus solitarius and its nucleus; the nucleus and descending root of the trigeminal nerve; the reticular substance; the dorsolateral part of the inferior olivary nucleus; the dorsal and ventral spinocerebellar, thalamo-olivary and spinothalamic tracts; parts of the cuneate and the medial vestibular nucleus, and the lateral part of the dorsal accessory olivary nucleus (fig. 5*A*). In cresyl violet preparations the involved area was filled with compound granular corpuscles. The ganglion cells of the nuclear masses showed various pathologic changes. The intima of the left posterior inferior cerebellar artery was thickened; the lamina elastica was broken down, and the lumen was obliterated. Sections of the medulla oblongata through the crossing of the lemnisci showed paleness of the left side of the medulla oblongata, involving the nucleus and descending root of the trigeminal nerve, the ventral and dorsal spinocerebellar tracts, part of the internal arcuate fibers and the lateral reticular nucleus (fig. 5*B*).

Comment.—The clinical syndrome in this instance, as in the first case, except for the bilateral sensory disturbances of the face was typical of closure of the posterior inferior cerebellar artery. The contralateral sensory disturbances of the face may have been due to involvement of the central tract of the fifth nerve after the fibers had decussated, while the homolateral sensory disturbances of the face were caused by involvement of the spinal root of the fifth nerve on the side of the lesion.

Histopathologically, there were multiple vascular insults. The main lesion was in the distribution of the left posterior inferior cerebellar artery, destroying part of the lobulus paramedianus and lobulus ansiformis crus 2 and the structures on the dorsolateral surface of the medulla oblongata. The lateral branch of the posterior inferior cerebellar artery, which supplies the lower two thirds of the inferior surface of the cerebellum, was less involved than the medial branch. In contrast to the occlusion in the first case, there was obstruction of the posterior inferior cerebellar artery at the point where it divides into the lateral and medial branches, thus causing partial destruction of the cerebellar lobes.

CASE 3.—*Slight signs of cerebellar involvement on the right, difficulty in deglutition and paresis of the right side of the palate; multiple cerebral vascular insults; incomplete occlusion of the medial branch of the right posterior inferior cerebellar artery with slight destruction of the nucleus and descending root of the fifth nerve, the corpus restiforme, the nucleus ambiguus and the dorsal and ventral spinocerebellar tracts.*

History.—J. T., a man aged 28, who was admitted to the Montefiore Hospital on Feb. 25, 1932, complained of dizzy spells, headache in the right temporal region, weakness, diplopia and occasional nausea and vomiting since 1930. A diagnosis of hypertension was made in September 1931. In January 1932 paralysis of the right side and difficulty in speech and swallowing suddenly developed.

Neurologic Examination.—There were slight ataxia in performing the finger-to-nose and finger-to-finger tests and a tendency to dysmetria and past pointing, but no adiadokokinesis or Gordon Holmes phenomenon. Simple and moderately complex verbal commands were understood. There was, however, slight clumsi-

ness in the performance of simple acts with the right hand, but no ascertainable evidence of aphasia or apraxia. On the right there were exaggerated deep reflexes, exhaustible patellar and ankle clonus and Rossolimo and Mendel-Bechterew signs; on the left a Babinski sign was elicited. There were no sensory disturbances. The pupils reacted sluggishly to light. Supranuclear facial paresis was present, as were also spontaneous laughing and crying. There was paresis of the palate on phonation and stimulation. The speech was slow, nasal and dysarthric. The trapezius muscles were weak, the left more than the right. The tongue could not be protruded and deviated to the right.

Laboratory Data.—The Wassermann reaction of the blood and the spinal fluid was negative. The blood pressure was 180 systolic and 130 diastolic.

Clinical and Anatomic Diagnosis.—The diagnosis was: hypertension; multiple cerebral thromboses; pseudobulbar paralysis, and incomplete thrombosis of the right medial branch of the posterior inferior cerebellar artery.

Autopsy.—Gross Examination: The vessels at the base of the brain showed atherosclerotic plaques. There were punctate hemorrhages at the tip of the left caudate nucleus. Areas of softening were present in the inferior part of the internal capsule, caudate nucleus and putamen on the left and in the globus pallidus, putamen, internal capsule and pulvinar on the right. There were areas of softening the size of a pinpoint in the medulla oblongata and in the region of the right nucleus and descending root of the fifth nerve.

Microscopic Examination: Sections through the nuclei of the sixth nerve showed secondary degeneration of both pyramids. Sections of the medulla oblongata through the nuclei of the tenth nerve in myelin sheath preparations disclosed a slightly shrunken right half with a small area of softening in the region of the right nucleus and descending root of the fifth nerve (fig. 6*A*). With higher magnification there was evident destruction of the nucleus and descending root of the fifth nerve and parts of the corpus restiforme, the nucleus ambiguus and the dorsal and ventral spinocerebellar, thalamo-olivary and spinothalamic tracts. In sections near the crossing of the lemnisci there was degeneration of the right nucleus and descending root of the trigeminal nerve, the lateral reticular nucleus and the dorsal and ventral cerebellar and spinothalamic tracts (fig. 6*B*). The pyramids showed descending demyelinization.

Comment.—The slight signs of cerebellar involvement and paresis of the palate on the right could easily be explained by the lesion of the corpus restiforme, the cerebellar tracts and the nucleus ambiguus. We are at a loss to explain the absence of sensory disturbances over the right side of the face in the presence of the outstanding involvement of the nucleus and descending root of the trigeminal nerve. Undoubtedly, many clinical findings were masked by the multiplicity of lesions in the cerebral vessels. As in many cases of involvement of the medial branch of the posterior inferior cerebellar artery, the cerebellum was completely spared. Examination of the area of the medulla oblongata convinced us that the lateral branch was not involved in this case. We also demonstrated, as did Foix and his pupils, that this part of the medulla oblongata may at times be supplied by the lateral artery of the medulla oblongata, a branch of the basilar or vertebral artery.

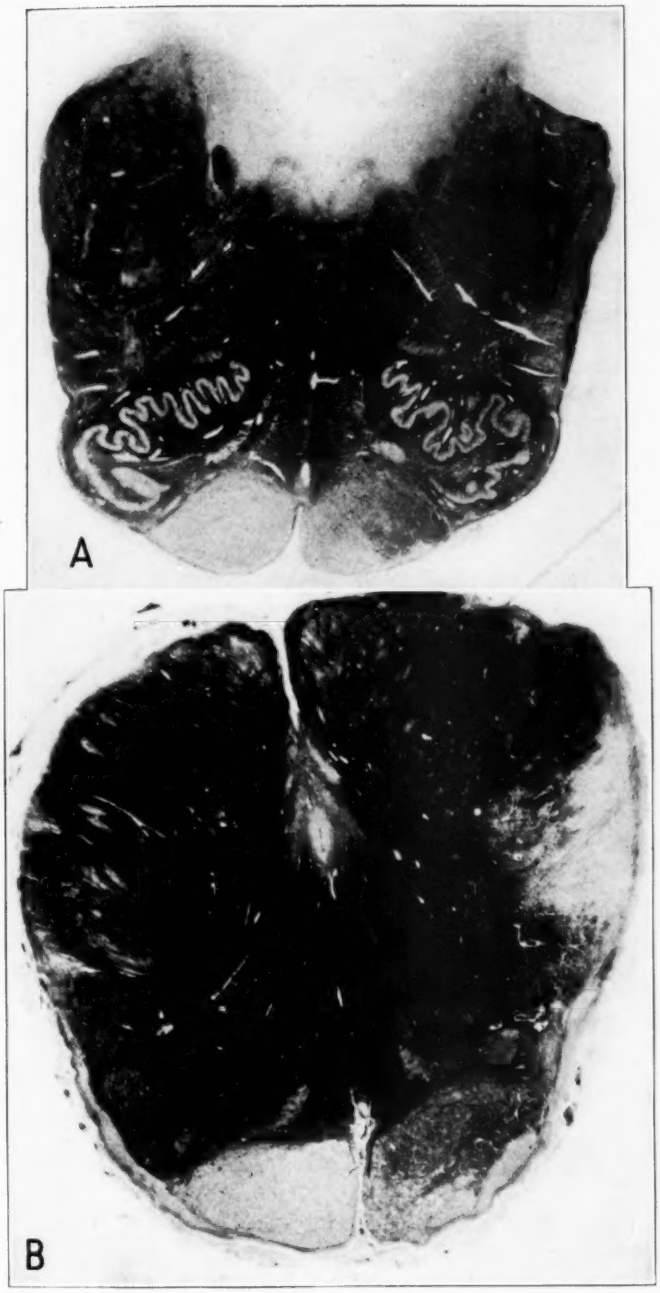

Fig. 6 (case 3).—*A* shows a section of the medulla oblongata through the nuclei of the tenth nerve, with a small area of softening in the region of the right nucleus and descending root of the fifth nerve and slight destruction of the dorsal and ventral cerebellar, thalamo-olivary and spinothalamic tracts. The demyelinization of the pyramids was a descending degeneration. Myelin sheath stain. *B* shows a section near the crossing of the lemnisci, with an area of destruction in the region of the right nucleus and descending root of the trigeminal nerve, the lateral reticular nucleus and the dorsal and ventral cerebellar and spinothalamic tracts. Myelin sheath stain.

CASE 4.—*Absence of signs of cerebellar involvement; death shortly after closure of the lateral branch of the right posterior inferior cerebellar artery; destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocccularis and lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis on the right side.*

History.—S. T., a woman aged 66, who was admitted to the Montefiore Hospital on July 24, 1925, had suffered sudden paralysis of the left side and loss of speech in October 1924.

Neurologic Examination.—There were: left spastic hemiplegia; supranuclear paralysis of the left side of the face; bilateral hyperreflexia, on the left more than on the right; a bilateral Hoffmann sign, and a Babinski sign on the left. There were slight impairment of all forms of sensation and astereognosis on the left side of the body.

Course.—On March 6, 1927, the patient complained of severe headache and nausea. Soon after, she began to vomit, became stuporous and could be aroused only by loud commands. Breathing was stertorous; the face was flushed; the pupils were constricted but reacted to light, and there were signs of involvement of the right pyramidal tract. Two days later pulmonary edema developed, and the patient died on March 8, 1927.

Autopsy.—Gross Examination: There was an area of softening along the distribution of the right anterior and right posterior temporal branches of the middle cerebral artery. The lower two thirds of the lobulus paramedianus, lobulus paraflocccularis and lobulus ansiformis crus 2 on the right side was softened. The lateral branches of the right posterior inferior cerebellar artery were occluded.

Microscopic Examination: In myelin sheath preparations, sagittal sections of the cerebellum disclosed destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocccularis and lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis on the right (fig. 7). In cresyl violet preparations these cerebellar convolutions were filled with compound granular corpuscles, and the Purkinje cells showed pathologic changes. The lateral branches of the right posterior inferior cerebellar artery disclosed thickening of the intima, splitting of the lamina elastica and obliteration of the lumen.

Comment.—Clinically, this patient showed absence of signs of cerebellar involvement, because the closure of the lateral branches of the posterior inferior cerebellar artery occurred shortly before death. The medial branch which supplies the dorsolateral part of the medulla oblongata was uninvolved. The destroyed cerebellar lobes corresponded to the area of the distribution of the lateral branch of the posterior inferior cerebellar artery.

CASE 5.—*Absence of signs of cerebellar involvement; death shortly after rupture of the lateral branch of the left posterior inferior cerebellar artery; destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocccularis and lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis on the left.*

History.—H. C., a man aged 64, was admitted to the Montefiore Hospital on Jan. 8, 1927, with a history of a sudden attack of dizziness and momentary loss of

speech in September 1926. After being confined to bed for several weeks he was again able to walk, but the left leg remained somewhat stiff.

Neurologic Examination.—There were: slow, stiff gait, with short steps; on the left, paresis of the extremities, loss of associated movements, slightly increased deep reflexes, Mendel-Bechterew and Rossolimo signs, a doubtful Babinski sign and slightly diminished abdominal reflexes; weakness of both external rectus muscles and of the left internal rectus muscle, nystagmus on lateral gaze, and supranuclear palsy on the right side of the face.

Course.—On May 8, 1928, the patient became unconscious; the pupils were the size of a pinpoint and failed to react to light; clonic convulsive movements soon followed. Examination of the fundus disclosed moderate arteriosclerosis. The patient died on the same day.

Fig. 7 (case 4).—Sagittal section of the cerebellum, showing destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocculari s and lobulus ansiformis crus 2 on the right and the lobulus A vermalis and lobulus B vermalis as a result of occlusion of the right lateral branch of the posterior inferior cerebellar artery. Myelin sheath stain.

Laboratory Data.—The blood pressure was 190 systolic and 110 diastolic. The Wassermann reaction of the blood and of the spinal fluid was negative. All other laboratory data were normal.

Clinical and Anatomic Diagnosis.—The diagnosis was multiple cerebrovascular insults and rupture of the left posterior inferior cerebellar artery and the right pontile branch of the basilar artery.

Autopsy.—Gross Examination: The left cerebellar hemisphere was larger than the right and was covered by a blood clot. On removing part of the clot on the surface of the cerebellum, an opening 0.5 cm. in diameter was noted which

was continuous with a larger cavity filled with blood destroying the greater part of the lobulus paramedianus and lobulus paraflocculari on the left and part of the lobulus ansiformis crus 2 on the same side (fig. 8). A second hemorrhage was present on the right, extending from the midbrain to the upper part of the pons. The lateral, third and fourth ventricles were filled with coagulated blood.

Microscopic Examination: Sections of the cerebellum disclosed an extensive hemorrhage which destroyed the greater part of the white and gray matter of the lower two thirds of the lobulus paramedianus and lobulus paraflocculari, part of the lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis on the left side (fig. 8). In cresyl violet preparations the area was seen to be filled with red cells and compound granular corpuscles; the latter and the Purkinje cells contained blood pigment. Another small hemorrhage on the right side of the pons destroyed part of the brachium pontis and part of the nuclei of the sixth, seventh and eighth nerves. The medulla oblongata disclosed descending degeneration of the left pyramid. The lateral branch of the left posterior inferior cerebellar artery and the right pontile branch of the basilar artery were ruptured.

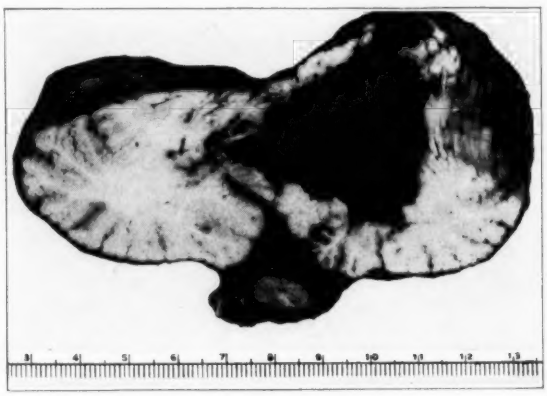

Fig. 8 (case 5).—Rupture of the left lateral branch of the posterior inferior cerebellar artery with destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocculari and lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis.

Comment.—Clinically, the patient presented neurologic signs of diffuse cerebrovascular disease. Rupture of the lateral branch of the left posterior inferior cerebellar artery and of pontile branches occurred shortly before death. Signs of cerebellar involvement could not be elicited because of the comatose state. Anatomically, there was involvement of the lower two thirds of the lobulus paramedianus, lobulus paraflocculari and lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis.

CASE 6.—*Signs of cerebellar involvement in the right upper extremity; partial occlusion of the right anterior inferior cerebellar artery; destruction of the upper parts of the lobulus paramedianus and lobulus ansiformis crus 2 on the right.*

History.—L. B., a woman aged 47, who was admitted to the Montefiore Hospital on July 29, 1934, had had attacks of dizziness, vomiting and slight occipital headaches in 1926. A diagnosis of essential hypertension was made. In December 1931 she suddenly experienced weakness in the right arm and leg and clumsiness in dressing and in feeding herself. In January 1934 her mouth was drawn to the left and she had difficulty in talking; six months later she complained of choking spells and dyspnea.

Neurologic Examination.—There were shuffling gait, slight bilateral tremor in the finger-to-nose test, ataxia in the finger-to-finger test, more marked on the right, and generalized weakness of all muscle groups. All the reflexes were slightly hyperactive; there was a Hoffmann sign on the right, without other pathologic reflexes. There were no disturbances in sensation. The

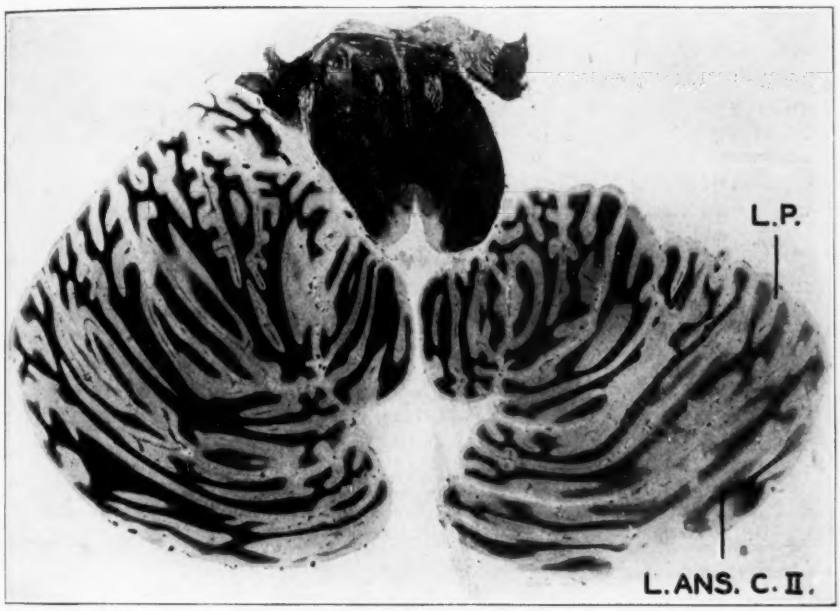

Fig. 9 (case 6).—Thrombosis of the right anterior inferior cerebellar artery with destruction of the upper third of the lobulus paramedianus (*L.P.*) and lobulus ansiformis crus 2 (*L.Ans. C II*) on the right side.

veins of the ocular fundi were dilated; the arteries were thin and tortuous; there were several large hemorrhages, and the margins of the disks were blurred. The pupils were equal and reacted to all stimuli. There were supranuclear weakness of the left side of the face and spasmodic crying. The movements of the palate and the gag reflex were normal; there was no dysarthria. The tongue protruded in the midline.

Course.—On Oct. 10, 1934, the patient became confused, partially disoriented and agitated. Later acute pulmonary edema developed, and the patient died on Oct. 29, 1934.

Laboratory Data.—The blood pressure was 260 systolic and 140 diastolic. The urea nitrogen content was 17.3 mg. per hundred cubic centimeters. The

Wassermann reaction of the blood and the spinal fluid and the other laboratory data were normal.

Clinical and Anatomic Diagnosis.—The diagnosis was cerebral and cerebellar arteriosclerosis and thrombosis of the right anterior inferior cerebellar artery.

Autopsy.—Gross Examination: The basilar, cerebellar and vertebral arteries contained numerous atheromatous plaques. The left vertebral artery was larger than the right, and the right anterior inferior cerebellar artery was occluded. The brain was cut coronally. There were several small areas of softening in the thalamus and putamen on each side and in the right corpus callosum and right pallidum. There was an area of softening in the upper third and on the inferior surface of the lobulus paramedianus and lobulus ansiformis crus *2* on the right. The cerebellum was cut horizontally. The cerebellar folia and part of the white matter in the regions just mentioned were softened.

Microscopic Examination: Myelin sheath preparations of sections of the cerebellum disclosed demyelinization of the fibers of the upper part of the right lobulus paramedianus and the right lobulus ansiformis crus *2* (fig. 9). In cresyl violet sections the gray and white matter of these areas were filled with compound granular corpuscles. The granular and molecular layers were destroyed, and most of the Purkinje cells showed various pathologic changes. The lumen of the right anterior inferior cerebellar artery was occluded by a thrombus; the intima was thickened, and the media was calcified.

Comment.—The weakness of the right arm and leg and the clumsiness in dressing and feeding, as well as the slight tremor and ataxia on the right side, can be accounted for by the partial destruction of the lobulus paramedianus and lobulus ansiformis crus *2* on the right, because of the occlusion of the right anterior inferior cerebellar artery. All the other neurologic signs were caused by the multiple cerebral vascular insults. Evaluation of signs of cerebellar involvement is often difficult in cases of multiple vascular lesions. This is especially true of signs due to occlusion of the anterior inferior cerebellar artery. As far as we know, this is the first case on record of thrombosis of the anterior inferior cerebellar artery.

COMMENT

The syndrome of occlusion of the posterior inferior cerebellar artery is characterized by homolateral signs of cerebellar involvement, sensory disturbances of the face, corneal hypesthesia, paresis or paralysis of the soft palate and the vocal cord and contralateral sensory disturbances of the body. Occasionally there are a Horner syndrome on the same side and vertigo, nystagmus, dysphagia and dysarthria. This syndrome has been recorded by Wallenberg,[5] Senator,[7] Reinhold,[8] van Oordt,[9]

7. Senator, H.: Zur Diagnostik der Herderkrankungen in der Brücke und dem verlängerten Mark, Arch. f. Psychiat. **14**:643, 1883.

8. Reinhold, H.: Beiträge zur Pathologie der acuten Erweichungen des Pons und der Oblongata, Deutsche Ztschr. f. Nervenh. **5**:351, 1894.

9. van Oordt, J. F. E.: Beiträge zur Lehre von der apoplektiformen Bulbärparalyse, Deutsche Ztschr. f. Nervenh. **8**:183, 1895-1896.

Babinski and Nageotte,[10] Breuer and Marburg,[11] Thomas,[12] Spiller,[13] Schwarz,[14] Goldstein and Baum,[15] Foix, Hillemand and Schalit,[3] Wilson and Winkelman,[16] Merritt and Finland,[17] Hall and Eaves [18] and others.

It is to be emphasized that this syndrome usually occurs in cases of involvement of the medial branch of the posterior inferior cerebellar artery, which supplies the dorsolateral part of the medulla oblongata. Complete occlusion of the posterior inferior cerebellar artery, which is seldom observed, should cause destruction of the dorsolateral portion of the medulla oblongata and of the lower two thirds of the lobulus paramedianus, lobulus paraflocculari s and lobulus ansiformis crus *2* and the lobulus A vermalis and lobulus B vermalis. Cases in which the medulla oblongata and part of these cerebellar lobules have been involved were recorded by Vulpian,[19] Hun,[20] Richter,[21] Winther [22] and others. The second case in our series falls in this group. Cases in which lesions of the posterior inferior cerebellar artery caused softening of parts of the aforementioned cerebellar lobules without involvement of the medulla

10. Babinski, J., and Nageotte, J.: Hémiasynergie, latéropulsion et myosis bulbaire, Nouv. iconog. de la Saltpêtrière **15**:492, 1902.

11. Breuer, R., and Marburg, O.: Zur Klinik und Pathologie der apoplektiformen Bulbärparalyse, Arb. a. d. neurol. Inst., a. d. Wien. Univ. **9**:181, 1902.

12. Thomas, H. M.: Symptoms Following the Occlusion of the Posterior Inferior Cerebellar Artery, J. Nerv. & Ment. Dis. **34**:48, 1907.

13. Spiller, William G.: The Symptom Complex of Occlusion of the Posterior Inferior Cerebellar Artery, J. Nerv. & Ment. Dis. **35**:365, 1908.

14. Schwarz, E.: Ueber den anatomischen mit klinischen Befund bei Verschluss der Arteria cerebelli posterior inferior, Monatschr. f. Psychiat. u. Neurol. **32**:132, 1912.

15. Goldstein, K., and Baum, H.: Klinische und anatomische Beiträge zur Lehre von der Verstopfung der Arteria cerebelli posterior inferior, Arch. f. Psychiat. **52**:355, 1913.

16. Wilson, G., and Winkelman, N. W.: Occlusion of the Posterior Inferior Cerebellar Artery, J. Nerv. & Ment. Dis. **65**:125, 1927.

17. Merritt, H., and Finland, M.: Vascular Lesions of the Hind-Brain (Lateral Medullary Syndrome), Brain **53**:290, 1930.

18. Hall, A. J., and Eaves, E. C.: Posterior Inferior Cerebellar Thrombosis (Autopsy), Lancet **2**:975, 1934.

19. Vulpian, cited by Tchernysheff and Grigorowsky.[27]

20. Hun, H.: Analgesia, Thermic Anaesthesia, and Ataxia, Resulting from Foci of Softening in the Medulla Oblongata and Cerebellum Due to Occlusion of the Left Inferior Posterior Cerebellar Artery, New York M. J. **65**:513, 581 and 613, 1897.

21. Richter, H.: Anatomische Veränderungen nach Verschluss der Arteria cerebelli inferior posterior mit retroolivärem Erweichungsherd, Arch. f. Psychiat. **71**:272, 1924.

22. Winther, K.: Un cas d'occlusion de l'artère cérébelleuse postérieure inférieure vérifié à l'autopsie, avec des douleurs et de l'hyperalgésie au froid, Acta psychiat. et neurol. **2**:399, 1927.

oblongata have been reported by Schwarz,[14] Mader,[23] Brouwer and Coenen,[24] Haike and Lewy,[25] Schaffer[26] and Tchernysheff and Grigorowsky[27] (cases 2 and 6).

The picture in the first two cases in this series conformed clinically to the classic syndromes of occlusion of the posterior inferior cerebellar artery; that in the last three cases, less so. The sixth case was an instance of occlusion of the anterior inferior cerebellar artery. A clinical and anatomic analysis of these cases may help in the understanding of this syndrome.

CLINICAL AND ANATOMIC CONSIDERATIONS

Signs and Symptoms of Cerebellar Involvement.—These are due generally to involvement of the corpus restiforme and the direct and indirect cerebellar tracts and possibly of the olivocerebellar tract. When parts of the cerebellar lobes are involved, the symptoms of cerebellar involvement may be ascribed to them. Signs and symptoms of cerebellar involvement were absent in cases 4 and 5 because the lesions in all probability occurred shortly before death. The signs of cerebellar lesions in the cases in this series consisted of abduction of the upper extremities, drooping of the shoulders, weakness of the extremities, intention tremor, broad-based gait, falling forward, backward or to one side, swaying, ataxia, past pointing and clumsiness in the performance of simple acts.

In cases 1 and 3 none of the cerebellar lobes were involved because only the medial branch of the posterior inferior cerebellar artery, which supplies the dorsolateral portions of the medulla oblongata, was implicated. In case 2, owing to the additional partial closure of the lateral branches of the posterior inferior cerebellar artery, there was also slight softening of the lobulus paramedianus and lobulus ansiformis crus 2. In cases 4 and 5 there was disease of the lateral branches of the posterior inferior cerebellar artery, resulting in destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocularis and lobulus ansiformis crus 2 and of the lobulus A vermalis and lobulus B vermalis. In case 5 the lateral branch of the posterior inferior cerebellar artery

23. Mader: Encephalomalacia lob. dex. cerebelli; vorübergehende cerebellare Symptome, Ztschr. f. Heilk. **1**:324, 1900.

24. Brouwer and Coenen, cited by Tchernysheff and Grigorowsky.[27]

25. Haike, H., and Lewy, F. H.: Klinik und Pathologie eines atypischen Falles von Verschluss der Art. cerebelli post. inf., Monatschr. f. Psychiat. u. Neurol. **36**:26, 1914.

26. Schaffer, K.: Ueber einige Bahnen des menschlichen Rhombencephalons, Ztschr. f. d. ges. Neurol. u. Psychiat. **46**:60, 1919.

27. Tchernysheff, A., and Grigorowsky, I.: Ueber die arterielle Versorgung des Kleinhirns, Arch. f. Psychiat. **89**:482, 1930.

was ruptured; in the other cases the process was due to thickening of the intima and obliteration of the lumen. Syphilis, which was a factor in several cases recorded in the literature, did not play a rôle in the pathologic process in the cases in this series.

Sensory Disturbances.—The homolateral sensory disturbances of the face due to involvement of the spinothalamic tract and the contralateral sensory disturbances of the body observed in the first two cases were caused by lesions of the nucleus and descending root of the trigeminal nerve and the spinothalamic tract, respectively. In case 1 there was also a subjective sensation of numbness over the left side of the body and the right side of the face, and there were questionable disturbances of the distal parts of the lower extremities referable to the posterior columns. In these instances (cases 1 and 2) there was occlusion of the medial branch of the posterior inferior cerebellar artery.

In the third case, clinically there were no homolateral sensory disturbances of the face. We cannot explain this phenomenon, unless the opposite nucleus and descending root of the trigeminal nerve supply both sides of the face. In this case the lesion of the lateral part of the medulla oblongata was small and was limited to part of the nucleus and descending root of the trigeminal nerve, part of the corpus restiforme and the nucleus ambiguus.

In cases 4 and 5 there was no involvement of the sensory pathways, as the lateral instead of the medial branch of the posterior inferior cerebellar artery was involved. The lateral branch, as already stated, supplies the cerebellum only.

It is to be emphasized that the sensory disturbances are usually limited to the components of the spinothalamic tracts. Therefore, the senses of touch, position, vibration, stereognosis, two point discrimination and pain on deep pressure, which are mediated by the medial lemniscus, usually remain intact, as the medial fillet is supplied at this level by the anterior spinal artery. The slight hyperesthesia of the opposite side of the body and the questionable loss of sense of position in the toes, noted only in case 1, were, indeed, probably due to the small lesion of the medial lemniscus. These rare disturbances in tactile and other sensations mediated by the medial lemniscus were described by Senator,[7] Hun,[19] Breuer and Marburg [11] and others.

The hypalgesia of the contralateral side of the face in case 2 may possibly be explained on the basis of occasional bilaterality of innervation of the face by the nucleus and descending root of the fifth nerve on one side, associated with a poorly developed corresponding component on the opposite side. Wallenberg described diminished sensations of pain and temperature on the opposite as well as on the same side of the face as the lesion; the contralateral sensory disturbances of the face lasted only for a few days. Wallenberg [5] explained the contralateral

sensory disturbances on the basis of involvement of the central tract of the fifth nerve after the fibers had decussated and the homolateral sensory disturbances on the basis of involvement of the spinal root of the fifth nerve on the side of the lesion.

Subjective sensory disturbances, which were observed only in case 1, are not uncommon. These were reported by a number of observers, and they consisted of sensations of numbness, cold, spontaneous pain, etc.

In case 1 there was absence of sensory disturbances over the neck between the third cervical segment and the sensory distribution of the fifth nerve. This observation, also recorded by others, may be accounted for by the gradual crossing of the sensory fibers from this region, so that they are not caught in the lesion.

The analgesia of the posterior part of the tongue, the fauces and the pharynx, noted only in the first case, was caused by involvement of the glossopharyngeal nerve or the tractus solitarius and its nucleus.

Other Clinical Findings.—The homolateral Horner syndrome in the first two cases, characterized by the miotic pupil, the narrow palpebral fissure and the enophthalmos, was caused by the implication of the sympathetic fibers in the medulla oblongata. These fibers, situated in the lateral reticular substance near the nucleus ambiguus and the descending tract of the trigeminal nerve, which supply the face and eye and receive their blood supply from the medial branch of the posterior inferior cerebellar artery, are uncrossed at this level of the medulla oblongata. Horner's syndrome is not always present, as shown in three of the cases in this series and in a number of others recorded in the literature.

Unilateral paralysis of the vocal cord and soft palate, dysphagia and occasional dysarthria are caused by lesions of the nucleus ambiguus, which is supplied by the medial branch of the posterior inferior cerebellar artery. This nucleus was involved in the first three cases. Slowing of the pulse due to irritation of the nucleus of the tenth nerve, recorded by several observers, was not noted in these cases.

A common symptom and one usually complained of first is dizziness. This symptom and nausea, vomiting and nystagmus were noted in cases 1, 2, 3, 5 and 6. All these complaints may be caused by lesions of the vestibular nuclei, the vagus nerves and their nuclei or the cerebellum. The medial vestibular nucleus was observed to be involved in case 2. In the other cases of involvement of the medial branch of the posterior inferior cerebellar artery, the vestibular nuclei appeared intact. Disease of the cerebellum, noted in cases 4, 5 and 6, probably accounts for these symptoms.

Slight impairment of hearing, noted in case 2, may occasionally be encountered; this is probably caused by involvement of the cochlear

nuclei. Paralysis of muscles supplied by the abducens and facial nerves, occasionally reported by observers and caused by lesions of the nuclei of these nerves, was not observed in any of the cases. Diplopia, as noted in case 1 and as also reported by other investigators, is probably caused by a lesion of the nucleus of the sixth nerve, although in this case that nucleus appeared intact. Weakness and paralysis of the tongue, reported by Breuer and Marburg [11] (case 2), is uncommon, as the twelfth nerve is usually supplied by the anterior spinal artery.

Muscular weakness, as encountered in practically all the cases, is probably due to involvement of the cerebellum or its tracts or to coincidental lesions of the pyramidal pathways. The pyramidal tracts are seldom implicated in cases of closure of the posterior inferior cerebellar artery, because the pyramids in the medulla oblongata at this level are supplied by the anterior spinal or the vertebral artery. Weakness due to lesions of the pyramidal tracts can be readily differentiated from weakness due to involvement of the cerebellum by the associated signs of involvement of the pyramidal tracts.

In the case of occlusion of the anterior inferior cerebellar artery there were clinical signs of cerebellar involvement. The upper third of the lobulus paramedianus and lobulus ansiformis crus 2, which are supplied by this vessel, was partially destroyed. The other neurologic signs were caused by lesions in other parts of the central nervous system.

SUMMARY AND CONCLUSIONS

Five cases of occlusion of the posterior inferior cerebellar artery and one case of occlusion of the anterior inferior cerebellar artery are reported.

The picture in the first two cases, with occlusion of the medial branch of the posterior inferior cerebellar artery, conformed clinically to the classic syndrome of occlusion of the posterior inferior cerebellar artery. Homolateral signs of cerebellar involvement, sensory disturbances of the face, Horner's syndrome and paralysis of the palate and contralateral sensory disturbances of the body were presented. In the second case there were also contralateral sensory disturbances of the face. Histopathologically, there was destruction of the lateral part of the medulla oblongata from about the middle of the hypoglossal nucleus to the level at which the corpus restiforme enters the cerebellum. In a transverse section the following structures were involved: part of the corpus restiforme, the reticular substance, the nucleus ambiguus, the nucleus and descending root of the fifth nerve and the spinothalamic, dorsal and ventral spinocerebellar and olivocerebellar tracts. The posterolateral surface of the inferior olive, the dorsal accessory olivary nucleus, the thalamo-olivary fibers and the vestibular nuclei, as in the

first two cases, may also be involved. In the second case, as a result of the additional involvement of the lateral branch of the posterior inferior cerebellar artery, there was also partial destruction of the lobulus paramedianus and lobulus ansiformis crus 2.

In the third case there was incomplete occlusion of the medial branch of the posterior inferior cerebellar artery; in this case the picture did not conform clinically to the classic syndrome; only signs of cerebellar involvement and paresis of the palate were present.

In cases 4 and 5 there was occlusion of the lateral branches of the posterior inferior cerebellar artery, with destruction of the lower two thirds of the lobulus paramedianus, lobulus paraflocculari and lobulus ansiformis crus 2 and the lobulus A vermalis and lobulus B vermalis. As death occurred shortly after the ictus, signs of cerebellar involvement were not recorded.

In addition to the preceding symptoms and signs, several patients suffered from nausea, vomiting, vertigo, nystagmus, diplopia and weakness of the extremities.

In case 6 there was partial occlusion of the right anterior inferior cerebellar artery, with destruction of the upper third of the right lobulus paramedianus and right lobulus ansiformis crus 2, causing signs of cerebellar involvement on the right.

TUMOR INVOLVING THE FRONTAL LOBE ALONE

A SYMPTOMATIC SURVEY OF ONE HUNDRED AND FIVE VERIFIED CASES

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From observation at the operating table it is exceedingly difficult to describe with anything like scientific accuracy the limitations of a tumor in relation to the three subdivisions of the frontal lobe—the motor area, the premotor area and the frontal, or prefrontal, area. Not only does the tumor overlap the boundaries of these arbitrary subdivisions, but surrounding the tumor there are areas of vascular and proliferative changes that extend varying distances beyond the actual limits of the tumor. Takagi [1] described diffuse edema, with large perivascular spaces and dilatation of all the veins in the neighborhood, among the pathologic processes that surround the tumor. In 1913 he said:

> It is important to remember that when tumor develops in the brain and exists for a long time, alteration of the brain tissue even in regions remote from the tumor may occur. Failure to take this alteration into consideration may lead to disappointment when operation does not produce the desired result.

The change to which he referred was chiefly hyperplasia of the hemisphere in which the tumor is located.

In spite of these difficulties, it seemed desirable to my colleagues and myself to review our cases of tumor of the frontal lobe, and for this purpose cases of primary tumor confined almost entirely to the frontal lobe have been selected. These numbered one hundred and five; but if cases of tumor arising in adjacent parts of the brain and invading the frontal lobe, such as instances of multiple glioma and of metastatic tumor, had been included, the series would have been much larger. Critical analysis of the one hundred and five cases has been made with the hope that some contribution might be made to the knowledge of the constituent parts. My colleagues and I have tried to determine whether the clinical picture varies with the type of tumor and to determine the rate of growth.

From the Neurosurgical Clinic of the Hospital of the University of Pennsylvania.

Read at the Sixty-First Annual Meeting of the American Neurological Association, Montreal, Canada, June 4, 1935.

1. Takagi, I.: Arb. a. d. neurol. Inst. a. d. Wien. Univ. **29**:280, 1927.

Generally speaking, in this clinical analysis only two major types of tumor, the fibroblastoma and the glioma, will be recognized. In this series of one hundred and five cases, there were forty fibroblastomas and sixty-five gliomas; ninety might be described as unilateral and the remaining as bilateral. As to the age of the patients, the youngest patient with a fibroblastoma was 3 years old, and the oldest, 61; the youngest with a glioma was 8, and the oldest, 65.

If an effort is made to localize a tumor as occupying one or the other of the various portions of the frontal lobe, one might be influenced, as Puusepp [2] said, by the predominance of certain symptoms. For example, uniform disturbance of the olfactory sense indicates not only the site of the lesion but its location at the base of the lobe. Motor phenomena obviously point to a lesion near the precentral gyrus. Loss of memory and disorders of equilibrium—"frontal ataxia"—postulate a tumor that is either bilateral or situated between the lobes, with pressure on each. Tremor of the limbs suggests the location of the tumor in the deeper and posterior portion of the lobe.

Still more impossible, I believe, is the description of the boundaries of the tumor in terms of Brodmann's areas. Despite this, a clinical and statistical study of a large series of verified cases of tumor is distinctly helpful to the neurosurgeon in determining the localization of a tumor with sufficient accuracy to indicate the area to be explored, that is, whether it is temporal or frontal, frontal or parietal, etc. But any further contributions to the knowledge of localization of minute areas of the brain, such, for example, as are specified in the areas of Brodmann, will come not from the observations of the neurosurgeon at the operating table but from the experimental laboratory by stimulation with the electrode with the aid of such an apparatus as that of Horsley and Clarke.

FIBROBLASTOMA

In the majority of cases a meningeal fibroblastoma is a well encapsulated, slowly growing tumor which produces symptoms by compressing the brain. It has a predilection for certain well known sites of origin, largely influenced by the distribution of the arachnoid villi; and the actual point of origin can usually be determined at the operating table. For this analysis the forty cases of fibroblastoma have been divided into four groups: (1) cases of tumor of the sphenoid ridge; (2) cases of tumor of the olfactory groove; (3) cases of bilateral tumor of the frontal pole, and (4) cases of parasagittal fibroblastoma and other growths taking their origin from the meninges over the convexity of the frontal lobe.

2. Puusepp, L.: Tumoren des Gehirns; ihre Symptomatologie, Diagnostik und operative Behandlung, Dorpat, J. Mällo, 1928-1929.

Fibroblastoma of the Sphenoid Ridge.—Twelve of the patients had a meningeal fibroblastoma arising from the sphenoid ridge: seven from the lesser and five from the geater wing. Such tumors were discussed recently by Alpers and Groff,[3] who were able to create a clinical syndrome for each of these groups. In cases of tumor of the lesser wing there are usually primary atrophy of the optic nerve and homonymous hemianopia; in cases of tumor of the greater wing there is papilledema. In cases of tumor of the lesser wing there is greater likelihood of involvement of the structures adjacent to the sella turcica; hence, occasionally there is paralysis of the oculomotor nerve. If a tumor either of the lesser or of the greater wing extends into the anterior fossa, the olfactory nerve may be involved. Signs of ataxia were noted in

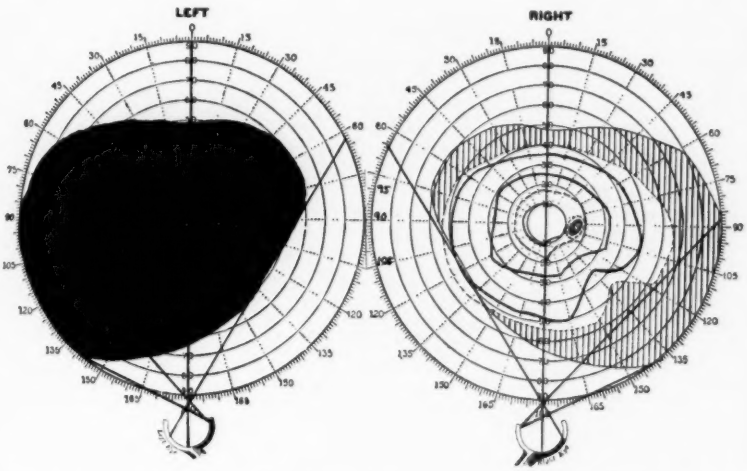

Fig. 1 (case 1).—The visual fields before operation. The patient was blind in the left eye. Vision in the right eye was 6/5.

one patient, mental changes and aphasia in another and slight mental changes in a third.

Case 1.—*History.*—H. E., a man aged 42, entered the University Hospital on Nov. 10, 1934, because of pain, exophthalmos and loss of vision in the left eye. In December 1931 a steady aching pain began in the left malar region and on the left side of the nose and lasted until April 1932. In October 1932 he became aware of easy fatigability and lack of energy. He had lost 20 pounds (9 Kg.). Blurring of vision, diplopia, exophthalmos and aching pain in the left eye appeared in July 1933, and the pain along the left side of the nose returned. Vision in the left eye gradually failed, and six months later the pain in the left

3. Alpers, B. J., and Groff, R. A.: Parasellar Tumors: Meningeal Fibroblastomas Arising from the Sphenoid Ridge, Arch. Neurol. & Psychiat. **31**:713 (April) 1934.

eye and the exophthalmos had increased. A roentgenogram taken at that time in another hospital revealed what was interpreted as an osteoma of the orbit. At that hospital an exploratory operation was performed, and the orbit was decompressed. What was described as thickened bone, but no osteoma, was found. The pain was not relieved, and the vision continued to fail, so that by April 1934 the patient was completely blind in the left eye.

Examination.—On admission to the Neurosurgical Service of the University Hospital the patient had pain in the distribution of the left maxillary division of the trigeminal nerve. There was slight exophthalmos of the left eye; the left pupil was slightly larger than the right, and the left eye was completely amaurotic. The left pupil reacted to indirect but not to direct light. The left optic disk showed primary atrophy. The right optic disk was normal, and the visual acuity was 6/5. There was a defect in the right inferior quadrant of the visual field of the right eye (fig. 1). The left corneal reflex was slightly diminished. Roentgenograms revealed unquestioned erosion of the lesser wing of the left sphenoid bone (fig. 2).

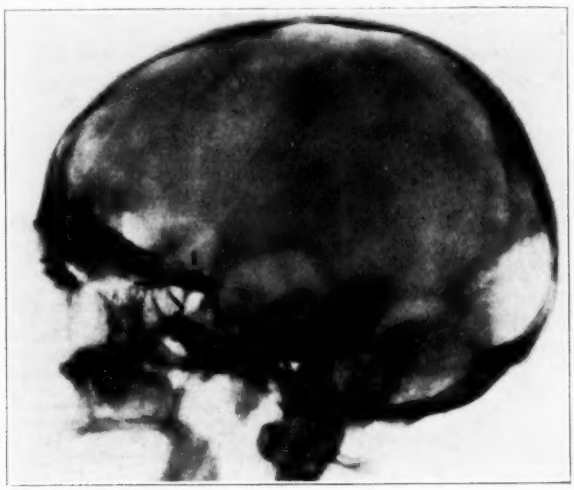

Fig. 2 (case 1).—Roentgenogram revealing destruction of the lesser wing of the sphenoid bone.

Operation.—On November 20 through a transfrontal exposure a tumor of the lesser sphenoid wing was revealed. The tumor had a long anteroposterior diameter (fig. 3); it extended over and around the left optic nerve and into the middle fossa and terminated over the second division of the gasserian ganglion. There were no difficulties attending removal of the tumor, and the patient made an uneventful recovery (fig. 4).

Pathologic Diagnosis.—The diagnosis was fibroblastoma.

Fibroblastoma of the Olfactory Groove.—In the six cases in which a fibroblastoma took origin in the olfactory groove the tumor occupied a part of both anterior fossae. The prevailing symptoms were anosmia, defects in the visual fields and hyperostosis. The optic disks were nor-

mal in three patients, hyperemic in one and choked in two. There is this difference between cases of tumor of the olfactory groove and cases of tumor arising from the lesser wing of the sphenoid bone: In the latter group primary atrophy of the optic nerve is not unusual.

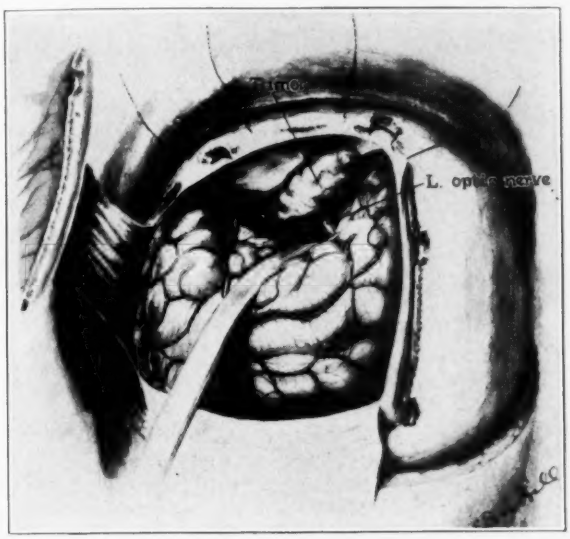

Fig. 3 (case 1).—Drawing made at operation, showing the tumor of the lesser wing of the sphenoid bone surrounding the left optic nerve.

Fig. 4 (case 1).—Photographs of the patient after removal of the fibroblastoma of the sphenoid ridge.

Anosmia was bilateral in three instances and unilateral in two (not tested in one, as the patient was stuporous). Hyperostosis due to the meningioma was present in three cases, and defects in the visual fields were noted in three; one defect was homonymous and another was bitem-

poral. There was a nasal defect in the visual field of one eye of a patient who was blind in the other. Neither mental symptoms nor ataxia was observed in any of these patients.

Case 2.—L. B., a woman aged 53, was admitted to the Neurosurgical Service of the University Hospital on March 27, 1933. It was reported that she had been in good health until four years previously, when she fell from a ladder and struck her head. Shortly after that a lump developed on the forehead. There had been occasional attacks of headache, but otherwise the patient had suffered no discomfort.

Examination at that time revealed little. The pupils did not react to light or in accommodation; there was weakness of the left side of the face, and the sense of smell was lost. Vision was 6/23 on the left and 6/12 on the right; the

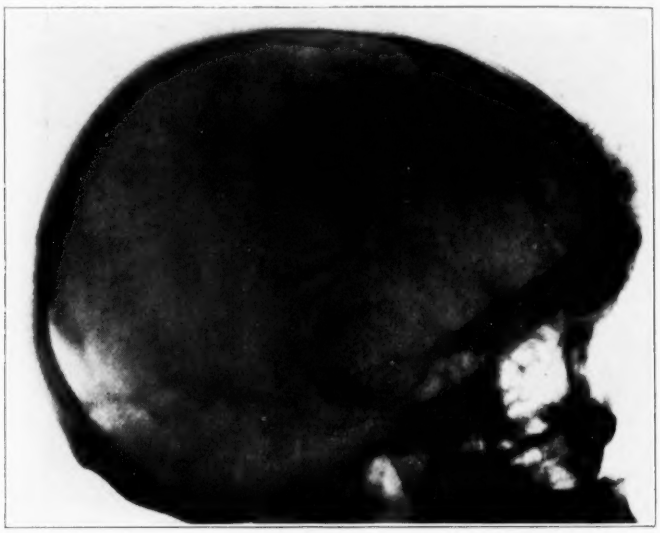

Fig. 5 (case 2).—Roentgenogram showing the hyperostosis and spicule formation overlying the fibroblastoma of the frontal lobe.

fields were normal. A roentgenogram revealed a shadow which was interpreted as representing either an osteoma or the hyperostosis of a meningioma (fig. 5). The patient was diabetic.

Later (June 20) the patient was readmitted, and a tumor of both frontal lobes was uncovered. It was adherent to the falx and lay just above the cribriform plate. It was removed in two stages and proved on examination to be a fibroblastoma (figs. 6 and 7). Recovery was uneventful.

Fibroblastoma of the Frontal Poles.—In the four cases of fibroblastoma the tumor was bilateral and extended little beyond the frontal poles. The cases were characterized by atrophy of the optic nerve, with loss of vision, and by roentgen evidence of a meningioma. In half the cases exophthalmos and anosmia were noted.

Fig. 6 (case 2).—Photograph of the hyperostosis after removal.

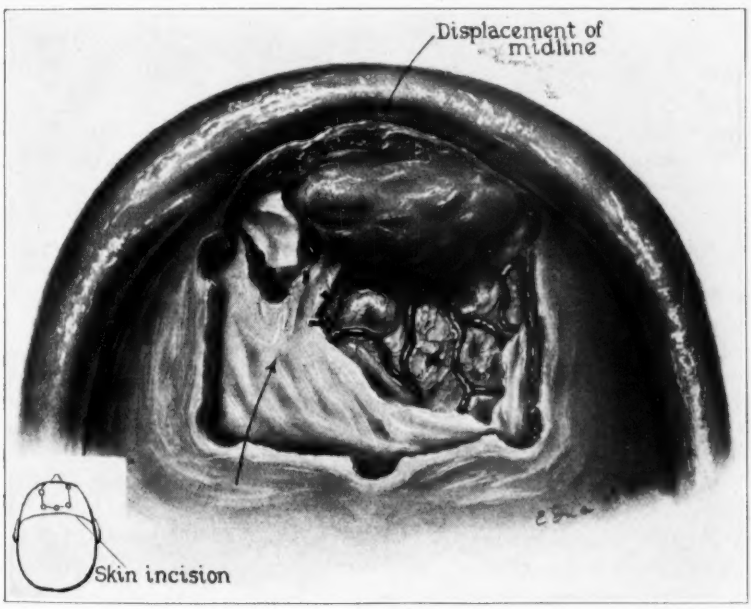

Fig. 7 (case 2).—Sketch of the tumor made at operation.

In one patient there was primary atrophy of both optic nerves; in another, there were primary atrophy of one optic nerve and a choked disk in the other eye. In two cases there was atrophy of the optic nerve but the type was not stated. Roentgenograms showed hyperostosis overlying the tumor in two cases, and in both a lump was readily palpable on the forehead. Erosion of the skull by tumor was noted in a third. Bilateral anosmia occurred twice, bilateral and unilateral exophthalmos once each and a binasal defect in the visual field once. Mental changes were observed in one patient; ataxia was not noted.

CASE 3.—*History.*—W. H., a boy aged 11 years, was referred to the neurosurgical service on July 2, 1934, by Dr. Thomas B. Holloway. In 1932 the boy began to notice blurring of vision, chiefly in the left eye. On March 4, 1934, it was remarked that he had ceased to make progress at school. It was recorded that in the spring of 1933 he had been struck on the head with a bat.

Fig. 8 (case 3).—Ventriculograms showing the enormously dilated right lateral ventricle and defects of both anterior horns and the anterior part of the third ventricle displaced posteriorly, indicating a tumor of both frontal poles.

Examination.—The left arm was smaller than the right, and there was definite weakness of both arms. The tendon reflexes were absent in the left arm and impaired in all the other limbs. In fact, the patellar and achilles tendon reflexes were absent on both sides.

There was atrophy of both optic nerves of the postpapillitic type. The nasal portion of the visual field of the left eye was lost, and there was some contraction of the field of the right eye. Vision in the left eye was lost, except for flashes of light. The Bárány report showed complete loss of vestibular function. There was lateral nystagmus.

Ventriculogram (Dr. Groff): The right ventricle was enormously dilated and the left ventricle less so. The third ventricle was displaced backward. Both anterior horns were encroached on, the left more than the right. The roentgenograms suggested a tumor of the left frontal lobe extending across the midline, in other words, a tumor of both frontal poles (fig. 8).

Operation.—The operation was divided into three stages. Because the lesion was bilateral, the coronal ear-to-ear incision was used. A hyperostosis was present in the frontal bone and proved to be so excessively vascular that its removal had to be accomplished in two stages (on July 5 and 12). The third stage was not undertaken until two months later (September 4). The old coronal incision was reopened, and as the flap was rolled forward there was bleeding from innumerable points. The dura was incised and the tumor exposed. That portion of the tumor on the periphery was soft and extremely vascular, whereas toward the central portion it was firmer and avascular. As much as possible of the tumor was scalloped out with an electrical loop, and a perfectly dry field was obtained with the aid of muscle grafts, silver clips and coagulation.

Pathologic Diagnosis.—The diagnosis was meningeal fibroblastoma (Dr. Alpers).

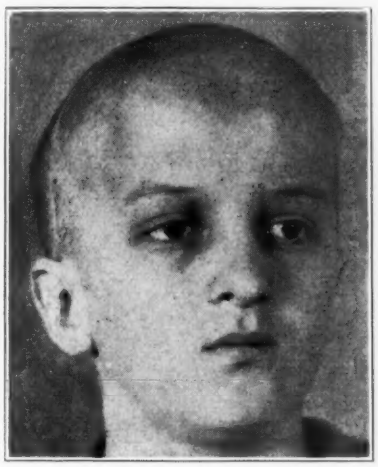

Fig. 9 (case 3).—Photograph taken after the operation, showing the coronal incision.

Result.—The boy made an uneventful recovery. He was last seen in April 1935, when vision had largely failed. Otherwise he was free from symptoms (fig. 9).

Although in the following case the tumor proved to be a ganglioglioma, the physical characteristics and location were so like those of a fibroblastoma of both frontal lobes that the case is reviewed here.

CASE 4.—*History.*—F. K., a woman aged 20, was transferred to the Neurosurgical Service of the University Hospital by Dr. Spiller on Oct. 25, 1933, with the chief complaint of convulsions. There was no family history of epilepsy or nervous or mental disease. The past history threw no light on the etiology of the attacks. Menses began at the age of 13 and had been regular since the onset. At 14 months mastoidectomy was performed for mastoiditis and was followed by erysipelas. Since that time the patient had had an intermittent discharge from the right ear.

The present illness began at the age of 13, when the patient began to have "running attacks." While walking down the street, for no apparent reason she would suddenly run for several hundred feet before stopping. The running was entirely involuntary, and on realizing what she had done the patient would feel foolish. Once she ran across the street in the midst of heavy traffic but was not injured. About nine or ten months after the onset the patient was stopped during one of the "running attacks" by her mother. She immediately became unconscious. During the second year of the illness convulsions appeared for the first time. An aura, consisting of an indescribable sensation in the epigastrium, was followed by a generalized convulsive attack, with unconsciousness followed by a period of drowsiness. Occasionally there were incontinence of urine during an attack and headache and vomiting following it. These seizures occurred several times a year.

In April 1933 turning the head and eyes to the right preceded the generalized convulsion. In the middle of September the patient had three severe convulsions associated with headache in the frontal region and vomiting.

A roentgenogram of the skull made at the Hahnemann Hospital showed a calcareous deposit in the midline in the frontal region.

Examination.—There were a discharge from the right ear and the scar of an old mastoidectomy. The audiometer indicated a 74.5 per cent loss of hearing in the right ear and a 30.2 per cent loss in the left ear. Physical and neurologic examinations revealed no abnormalities. There was no choked disk or defect in the visual fields.

A roentgenogram showed a thin shell of calcification in the midline in the frontal region, which was interpreted as being calcification within the capsule of a tumor. The ventriculograms were interesting and illuminating. The anterior horns of both lateral ventricles were flattened and displaced posteriorly. The most anterior portions of the horns appeared to be in contact with the shell of calcification, which has been described previously. Thus a diagnosis of a midline tumor of the frontal lobes was confirmed (fig. 10).

Operation.—First Stage (November 14): A coronal incision was made, and after the dural flap was reflected, with its base toward the longitudinal sinus, it was necessary to coagulate and cut two large superior cerebral veins to expose the frontal lobes as far mesially as the falx cerebri. A large cyst, 4 or 5 cm. in diameter, adjacent to the falx and extending anteriorly nearly to the frontal poles was disclosed. The pia-arachnoid forming the wall was thick and opaque. At first it was thought that this cyst might have accounted for the appearance of the encephalogram. However, when the cyst was opened and the right cerebral hemisphere was retracted laterally a large, solid tumor lying on the floor of the anterior fossa was exposed. It extended under the falx cerebri, a part of it lying under each frontal lobe. The tumor was readily separated from the normal brain. It had a slightly reddish appearance and was firm on palpation. It was unlike anything previously seen in this clinic.

With the Bovie unit a biopsy specimen was taken. In frozen sections it appeared not unlike a granuloma. As the tumor did not resemble a tuberculoma grossly, it was decided to proceed with the excision. This was carried out by removing the tumor bit by bit with the electrosurgical unit. By this method relatively little bleeding was encountered. After about three fourths of the tumor had been removed the systolic blood pressure fell to 50 mm. A blood transfusion was started, the wound was carefully closed and the removal of the remainder of the tumor was postponed until a second operation.

Pathologic Examination.—After further study with stains Dr. Alpers was of the opinion that the tumor should be classified as a ganglioglioma. It was vascular, and in places there was a perivascular infiltrate composed chiefly of lymphocytes. A thick capsule of connective tissue surrounded the tumor and sent numerous fibrous tissue strands into it. Many of the neoplastic cells had round or oval vesicular nuclei with coarse chromatin structure and no nucleoli—evidently astrocytes. Lobulated nuclei and multinucleated cells were numerous; among these cells were not a few with moderate and large vesicular nuclei and large, prominent nucleoli. When visible the cytoplasm trailed off into a swollen apical dendrite. No definite Nissl substance was observed in cells which looked like ganglion cells. No mitotic figures were seen. In some parts of the tumor fibrils

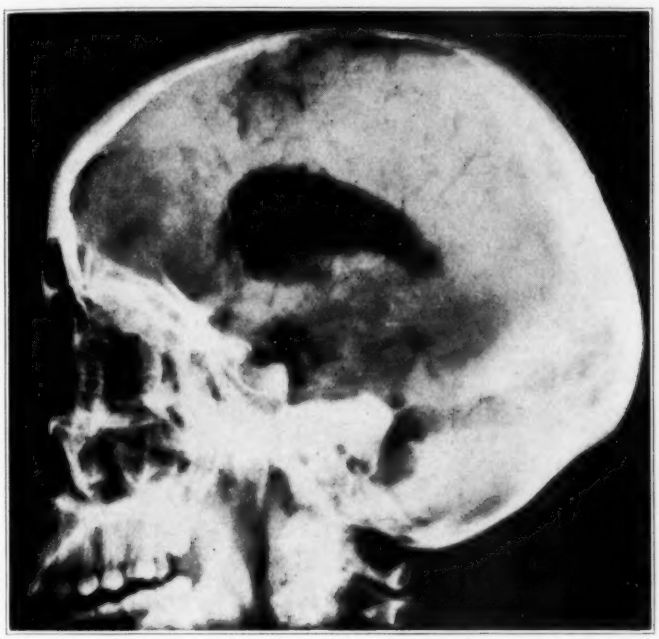

Fig. 10 (case 4).—Ventriculogram showing moderate dilatation of the lateral ventricles and a defect of both frontal horns, coinciding with the thin line of calcification presumed to be in the wall of a cystic tumor.

were in close connection with the cells, running in many directions. In other parts the fibrils were grouped together in bundles (fig. 11).

Parasagittal Fibroblastoma.—There were fifteen cases of tumor of this type including eight cases of parasagittal fibroblastoma and seven in which the growth arose from the meninges over the convexity of the frontal lobe. As a group the parasagittal fibroblastomas compressed to a varying degree the convolutions forming the superior lateral surface of the frontal lobe, that is, the frontal, premotor and precentral gyri, and thus may be contrasted with the tumors of the olfactory groove, which encroach chiefly on the base of the lobe.

The most common symptoms were ataxia (thirteen cases), paresis of the arm or face, alone or associated with hemiparesis (nine), and defects in the visual fields (eight). Somewhat less frequent were mental changes (eight), convulsions (six) and choked disk (six).

The frequency of ataxia, which I shall discuss at more length later, draws attention to the difficulties of differentiating a tumor of the frontal lobe from a cerebellar tumor. Signs suggestive of cerebellar involvement were prominent in six patients and present to a lesser

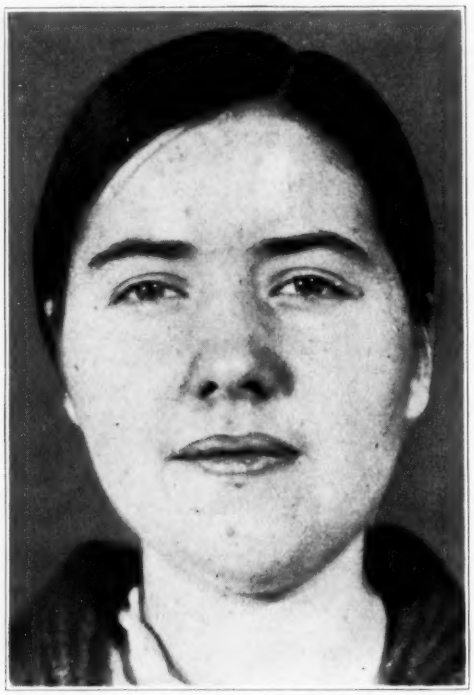

Fig. 11 (case 4).—Photograph of the patient. The excision extended coronally and to the hairline.

degree in seven others. They were bilateral in nine and unilateral in four instances (ipsilateral in one patient who had ipsilateral hemiparesis). The significance of observing ataxia in thirteen of the fifteen patients with parasagittal tumor and in only one of twenty-one patients with tumor of the sphenoid ridge, olfactory groove or both frontal poles will be referred to in the discussion of "frontal ataxia."

Defects in the visual fields are not anticipated in cases of tumor of the frontal lobe unless the growth is of basilar origin and directly involves the optic chiasm. However, nine of the fifteen patients with

a parasagittal tumor had defects; five were homonymous cuts, and one was bitemporal. Two of the tumors were so large, compressing areas 1, 2 and 3, that they might readily have encroached on the temporal lobe and given rise to homonymous defects in the visual fields. It is not easy to explain the appearance of the fields in the other cases.

Weakness of the contralateral side was observed in eight patients and of the ipsilateral side in one. This consisted in paresis of the entire side in five, of the arm alone in two, of the arm and face in one and of the face alone in one.

In contrast to the cases of fibroblastoma of the base and of the frontal pole, in the cases of parasagittal tumor there was not a single instance of primary atrophy of the optic nerve, and there was only one instance of anosmia.

CASE 5.—*History.*—L. D., a man aged 45, was transferred from the service of Dr. Spiller to the neurosurgical service on Feb. 21, 1934. He had become ill in the summer of 1930, with the sudden onset of a ravenous appetite, associated with excessive thirst, increased libido and somnolence. Generalized headaches began in 1932, and about that time he had the first of five convulsions. The convulsions began with turning the head and eyes to the left, and soon became generalized, the patient losing consciousness. Following the convulsions he was somnolent and often asked silly questions. His wife noticed that his expression had changed, and he frequently laughed at things that were not at all humorous. In 1932 the vision became blurred, and he often bumped into objects on his right side.

The headaches continued; the mental changes became more apparent, and three weeks before admission to the hospital it was noted that he walked with short steps, dragged the heels and often stepped backward to maintain his balance.

Mental Condition.—While the patient was under observation numerous mental changes were observed. Memory was greatly impaired, so that often he could not remember his street address. It was difficult to hold his attention in conversation and on examination. He was jocose and was not concerned about his illness. Although his bed was next to that of a patient who was critically ill, he was not alarmed about his own condition or about the contemplated operation. He slept considerably more than normal.

Examination.—There was bilateral choked disk of 3.5 diopters, with many hemorrhages and exudate on and around the disks. There were right homonymous defects of the fields, and the blind spots were greatly enlarged. The other cranial nerves were normal. Both motor power and sensation in the extremities were unimpaired. There was unsteadiness of gait and station, and he almost fell if unsupported; but the degree of generalized weakness could hardly have accounted for the ataxia. All the reflexes were normal.

Ventriculogram: This revealed a large filling defect in the anterior part of the right lateral ventricle, with displacement of the third ventricle and left lateral ventricle to the left.

Roentgenogram: There was an area of rarefaction in the right frontoparietal region, with what was believed then to be a benign frontal hyperostosis. This proved later to be the hyperostosis overlying the tumor.

Operation.—An exploratory craniotomy (first stage) was performed on March 6, 1934. The ventriculogram was convincing and pointed to a tumor which encroached on the anterior portion of the body of the right ventricle. A flap was fashioned so that the area of bone absorption seen in the roentgenogram would be included. It was with considerable difficulty and much bleeding that the bone of the flap was separated from the underlying dura. It was manifest that there was a large fibroblastoma, and while we had decided to divide the operation into two stages, a circular incision was made in the dura surrounding the underlying growth. The bone of the flap was removed and revealed both an area of absorption and an area of hyperostosis (figs. 12 and 13). As it became evident that the tumor arose from the falx, and before the wound was closed, sufficient bone of the superior margin of the cranial opening was removed with rongeur forceps to expose from

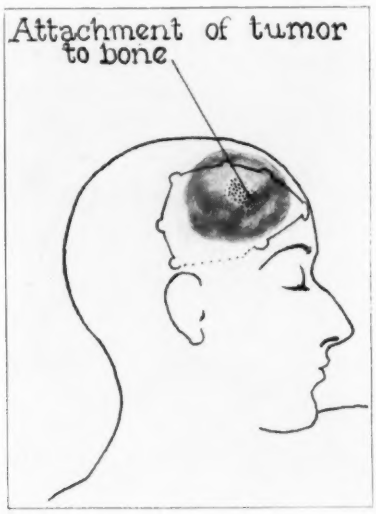

Fig. 12 (case 5).—Drawing showing the attachment of the tumor to bone.

2 to 3 cm. of the longitudinal sinus. During the operation the systolic blood pressure had fallen as low as 60, but it was 80 when the patient left the operating table. He had received 250 cc. of a 10 per cent solution of dextrose and 200 cc. of citrated blood.

Postoperative Course.—The patient was given a transfusion the night before the operation and again the following day. His condition at that time was excellent. On the third day, however, there developed hyperpyrexia and stupor, and he collapsed and died. At autopsy it was observed that removal of the tumor in toto would have been extremely difficult, that there was a large area of softening around the base of the tumor and that death was due to this degenerative process which involved the diencephalon.

Pathologic Report.—In the right frontal area was a large tumor which was firmly adherent to the dura (fig. 14). The latter could be pulled away, however, without too great trouble, leaving the surface of the tumor exposed. The tumor occupied almost the entire frontal lobe from the midline of the orbital

gyri, completely covering areas 1 and 2, except for a small area at the right frontal pole and compressing most of area 3. It compressed the right precentral gyrus, which was extremely hyperemic and was pushed up and somewhat herniated. The temporal lobe was not compressed. The right frontal lobe herniated somewhat across the midline.

The tumor was firm, hard and depressed in the middle of its outer surface. It lay embedded in the brain tissue and could be separated from it only with

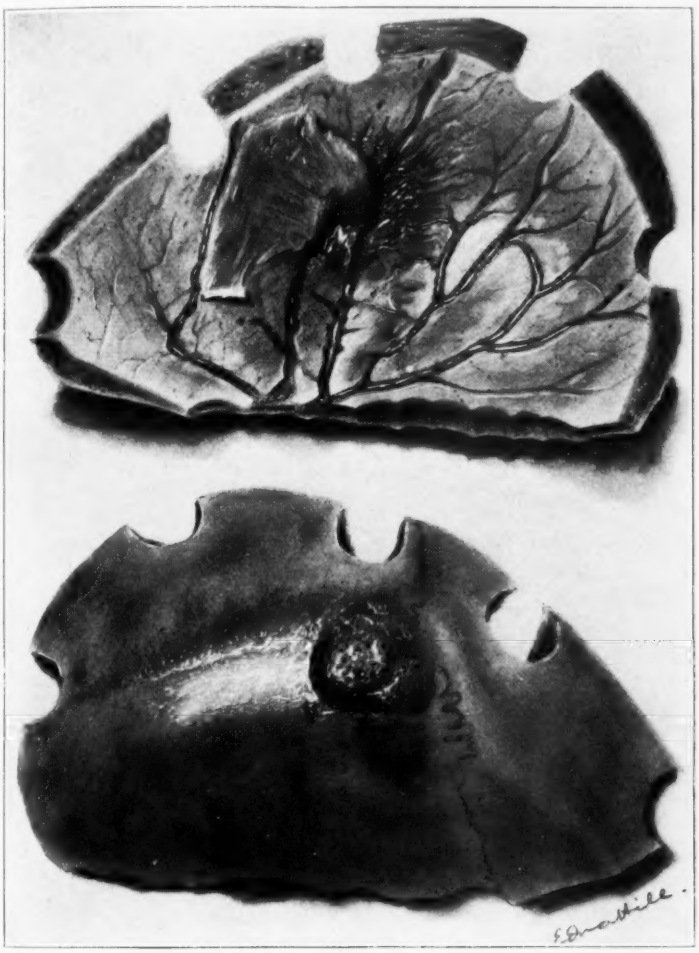

Fig. 13 (case 5).—Fibroblastoma. The upper figure shows a piece of the tumor attached to the inner table; the lower figure shows hyperostosis involving the outer table.

great difficulty. The edge of the tumor was firmly adherent to the adjacent edge of the brain and could be separated only by tearing the brain. The tumor spread out and flattened into a thin sheet at the longitudinal fissure and could hardly be separated there from the brain tissue.

The pia-arachnoid around the tumor had a clouded, milky appearance due to infiltration. That of the opposite hemisphere also was somewhat cloudy.

Section of the brain was made only through a few frontal planes. It was observed that the tumor could be separated from the brain but only with much force. The under-surface of the tumor was softened and necrotic. The tissue of the entire frontal lobe was greatly softened under the tumor.

Pathologic Diagnosis.—The diagnosis was fibroblastoma.

The interesting features in this case were the ravenous appetite and excessive thirst, the increased libido, the definite changes in personality and temperament, the generalized headaches and the convulsions. The choked disks, the definite changes in the skull and the ventriculogram established both the diagnosis and the localization. The patient

Fig. 14 (case 5).—A large fibroblastoma of the right frontal area which is firmly adherent to the dura.

unquestionably had a tumor of the frontal lobe. But the existence of somnolence should have forewarned us as to the possible invasion of the diencephalon, for it is generally conceded that somnolence is not an effect of dysfunction of the frontal lobe and is directly related to lesions of the diencephalon. Recognition of this beforehand perhaps would not have modified the management of the case. There is no question that the patient died not from the immediate effects of the operation but as the result of the softening in the diencephalon at the base of the tumor. The case illustrates to my mind one point, namely, that in considering the clinical effects of a tumor one must consider not only the tumor itself but definite and often extensive pathologic processes in its environment.

GLIOMA

In almost all cases a glioma originates beneath the cortex, but even when a tumor presents on the surface the precise limitations beneath the cortex are difficult to define on the operating table and cannot be determined unless the entire brain is sectioned. The rapidly growing glioblastomas and the slowly growing astrocytomas lend themselves, however, to a study of the effect of the rate of growth on the clinical course and clinical picture. As this is not primarily a pathologic study, gliomas of other types as well as some of the older specimens (which have not been studied microscopically) were placed together in a third group, so that the figures given here (seventeen cases of astrocytoma, eighteen of glioblastoma and forty of fibroblastoma) do not represent the true percentages of astrocytomas and spongioblastomas in the series.

Astrocytoma.—Seventeen verified cases of astrocytoma were studied, nine in men and eight in women. The youngest patient was 22, and the oldest 57, the average age being 38.1 years. Only one patient was hospitalized earlier than four months after the onset of the first symptom, and five were not hospitalized until two years or more had elapsed (one, two years; one, three years; two, seven years; one, twenty years). The average length of time was thirty-one and eight-tenths months. One patient with an astrocytoma in the motor area had a history of convulsive attacks which had begun in the right thumb twenty years previously. The tumor nodule and a part of the membrane lining the cyst were readily removed. Another patient, who had an astrocytoma removed from the left precentral gyrus in September 1920, returned in 1935 because of the recurrence of symptoms. The tumor was again extirpated, and the patient was discharged from the hospital in excellent condition.

CASE 6.—*History.*—R. M., a man aged 30, was admitted to the Neurosurgical Service of the University Hospital on Sept. 7, 1920, because of convulsions. In March 1919 he had his first convulsive attack, and during the following year he had twelve generalized convulsions. During the next six months he had jacksonian attacks, which began with flexion of the fingers, spread to the arm and right side of the neck and involved them in clonic movements. During the month before entering the hospital he had from two to three focal attacks a day. The patient had been married for two years and had one child aged 16 months. The wife had had no miscarriages.

Examination.—There was weakness of the right upper extremity, and the biceps and triceps reflexes were exaggerated. There were no pathologic reflexes, and in all other respects examination revealed no abnormalities. The Wassermann reaction of the blood and that of the spinal fluid were negative. The pressure of the spinal fluid was normal, and roentgenograms appeared to be normal.

Operation.—On September 17 an exploratory operation was performed for exposure of the motor area of the cortex on the left side. Occupying the upper

half of the field (fig. 15) was a sharply defined tumor, which was removed. It measured 5 by 6 cm. and extended up to the falx and about 3 or 4 cm. below the surface. On histologic study it proved to be an astrocytoma (fig. 16). Apart from a transitory aphasia the patient made an uneventful recovery, and he was discharged on October 4 (fig. 17).

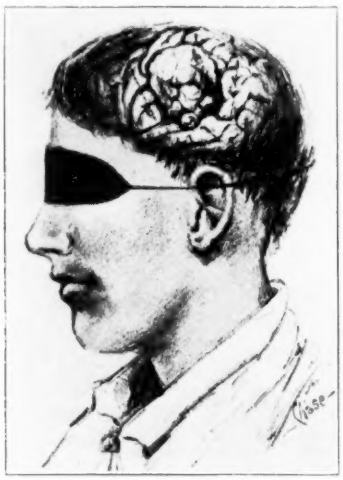

Fig. 15 (case 6).—A tumor of large dimensions removed at operation from a patient who had been subject to epileptic seizures. There were no other distinguishing features.

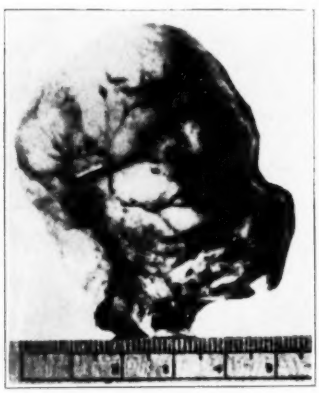

Figure 16

Figure 17

Fig. 16 (case 6).—Photograph of the tumor, an encapsulated glioma.
Fig. 17 (case 6).—Photograph of the patient two weeks after operation.

Comment.—There were a number of interesting features in regard to this case. First, in the course of the illness the convulsions, once general, became focal. Second, there was no increase in the intracranial pressure, and, third, the tumor was absolutely encapsulated. Neither before nor since have I seen an astrocytoma

so perfectly enclosed in a capsule. Grossly it had the appearance of a fibroblastoma. Often one sees an astrocytoma that on the surface presents fairly sharp definition but in the deeper aspects so infiltrates the brain that one cannot determine any line of demarcation.

Interval Course.—About one year following the operation the patient had one convulsive attack; he had had none since. In May 1934 there had developed a burning sensation in the palm of the right hand which extended into the fingers; since then there had been sixteen attacks, each lasting for about two minutes. During one attack the burning spread up to the elbow, and on several occasions the thumb or little finger twitched.

Second Admission.—On July 3 the patient was readmitted to the neurosurgical service. The right side of the face was slightly weak, and the tongue was deviated to the right. There was paralysis of the right arm, forearm, hand and shoulder. Sensation was normal, with the possible exception of stereognosis, and that could not be accurately tested. The right biceps, triceps, radial and ulnar reflexes were greatly exaggerated. The strength of the right lower extremity was normal, but in walking there was a slight tendency to drag the right foot. When the patient stood on the right foot with the eyes closed, there was a tendency to sway to the right. Sensation was normal. The patellar and achilles tendon reflexes on the right were hyperactive, and there were abortive patellar and ankle clonus and an indeterminate plantar response.

An encephalogram (July 4) showed that the left ventricle was slightly larger than the right; both were within the normal limits of size. There were no filling defects. An unusual amount of air was present over the cerebral cortex on both sides, and the basal cisterns were filled, indicating the presence of cortical atrophy. There was no encephalographic evidence of a tumor, and the patient was discharged.

Interval Course.—The burning sensation disappeared in the early part of August and did not return. In October the right side of the face and neck began twitching, in the following month the right leg became stiff, and the patient had difficulty in raising the right foot. From the middle of December he had had difficulty in choosing words, and speech was slurring, so he decided to return for study.

Third Admission.—On Jan. 3, 1935, the patient was again admitted to the neurological service. In addition to the previous findings, the right lower extremity was paralyzed. Both the right arm and the right leg were spastic. Sense of position was lost in the right index finger. The fundi and visual fields were normal.

Second Operation.—On January 8, with the area under local anesthesia an incision was made in the scalp which almost wholly surrounded the original incision of the osteoplastic flap. The bone flap was reflected, and when the dural flap was reflected upward the tumor was exposed. That portion of the tumor presenting on the surface was almost precisely in the site of the original growth. However, the recurrent tumor differed materially in its gross characteristics from the original growth in that it was almost wholly cystic. When the wall of a large cyst was removed it was seen that the tumor extended a considerable distance beneath the surface, both downward and forward. This accounted for the aphasia. The removal was incomplete because we did not wish to encroach on the speech area nor on the rolandic zone, as the patient previous to operation especially pleaded that, as far as locomotion was concerned, he be no further handicapped. Closure of the wound was carried out with the patient under ether anesthesia. The recurrent growth confirmed Dr. Alpers' diagnosis of the primary tumor—astrocytoma. The patient was discharged on January 21.

The incidence and nature of the mental changes, ataxia and motor and reflex changes did not differ greatly from those in the cases of fibroblastoma and glioblastoma. The duration of the disease in the cases of astrocytoma was comparable to that in the cases of fibroblastoma, and the results of operation were almost as good.

Glioblastoma.—There were eighteen cases of glioblastoma, five in women and thirteen in men. The youngest patient was 8 years old and the oldest 65, the average age being 39.2 years. Nine of the patients were hospitalized within three months of the onset of the first symptom and all except one within a year. The exception was a woman, aged 37, who came under observation six years after the appearance of the first symptom. After reexamining the sections made in that case, despite the duration of symptoms, I am still of the opinion that the tumor should be classified as a glioblastoma. The average duration of symptoms before hospitalization was five and one-tenth months (not including the case of the woman with the six year history).

Although in half the patients the course of the disease was very rapid after the onset of the first symptom, there were no other features that might be said to be characteristic of this particular tumor. Neither the percentage incidence of the symptoms and signs nor the clinical picture, considered as a whole, presented any striking differences when compared with those of patients with astrocytoma or fibroblastoma.

The case of a patient with a history of symptoms of only two months' duration, who proved to have a glioblastoma occupying almost the entire right frontal lobe, will be described as case 10.

COMMENT

Mental or Psychic Symptoms.—In opening a discussion of the clinical features of tumor of the frontal lobe one might with propriety consider first the mental and psychic symptoms. However, be it remembered that psychic disturbances are not pathognomonic of tumor of the frontal lobe; as is well known, they have been observed in patients with a tumor in another part of the brain, especially when the brain has been subjected to increased intracranial pressure for a long time. However, the prevalence of mental disturbances as one of the earliest signs in verified cases of tumor of the frontal lobe is ipso facto evidence of the localizing importance of these phenomena. Even with these limitations it may be worth while to discuss the different symptoms and signs as they appear in the neurosurgical records and to comment on their significance.

One or more symptoms characteristic of mental disturbance were recorded in sixty of the one hundred and five cases in this series;

Kolodny [4] recorded twenty-two in thirty-seven cases, and Sachs,[5] thirty-two in fifty cases.

The frequent association of mental symptoms with fibroblastoma, astrocytoma and glioblastoma does not differ greatly from one group to the other. However, when the cases of fibroblastoma are grouped according to the location and the symptoms are tabulated, it is apparent that mental symptoms frequently occur when the tumor is parasagittal or when it occupies both frontal poles but are rare in cases of tumor of the olfactory groove or of the sphenoid ridge. This indicates that the location of the tumor and not its nature is the more important responsible factor. Ziegelroth [6] stated that the bilateral distribution is of great importance, and Anton and Zingerle [7] went so far as to say that in a case of tumor of both frontal lobes, fixation of attention and concentration are so distorted that one may speak of idiocy or feeblemindedness characteristic of tumor of the frontal lobe.

TABLE 1.—*Incidence of Various Mental Phenomena*

	Tumor of			Total Number of Cases
	Right Side	Left Side	Both Sides	
Loss of memory	17	21	5	41
Loss of intelligence	14	16	5	34
Lack of attention or inability to concentrate	14	12	2	28
Change of personality	9	11	4	24
Disorientation	7	10	0	17
Emotionalism	7	3	2	12
Crying	3	1	0	4
Irritability	6	3	1	10
Witzelsucht	2	1	0	3
Euphoria	4	1	1	6
Childishness	2	3	1	6
Hallucinations	3	2	1	6
Indifference	3	2	0	5
Profanity	1	1	0	2
Apraxia	0	1	0	1
Aphasia	1	6	0	7

Perhaps the earliest sign of impairment of the function of the frontal lobes is loss of memory, chiefly for recent events. Often the patient complains of being unable to concentrate, and one finds it difficult to hold the patient's attention while taking the history and making an examination. Such a state would result in the making of inaccurate observations by the patient and might partly explain the loss of memory

4. Kolodny, A.: Symptomatology of Tumor of the Frontal Lobe, Arch. Neurol. & Psychiat. **21**:1107 (May) 1929.

5. Sachs, E.: Lesions of the Frontal Lobe: A Review of Forty-Five Cases, Arch. Neurol. & Psychiat. **24**:735 (Oct.) 1930.

6. Ziegelroth, L.: Arch. f. Psychiat. **77**:829, 1926.

7. Anton, C., and Zingerle, H.: Bau, Leistung und Erkrankungen des menschlichen Stirnhirns, Graz, Leuschner & Lubensky, 1902.

for recent events. Jacobsen's[8] observations on trained chimpanzees suggested that impairment of recent memory can be attributed specifically to a lesion of the frontal lobe.

> After injury to the frontal association areas, those activities which in their very nature demand integration over a period of time can no longer be effectively carried out. The subject seems unable to remember a single experience for even a few seconds in the face of new incoming sensory data, and temporal patterning of responses necessarily fails. The memory defect cannot be regarded as a generalized deterioration of intelligent behavior but appears to be a specific impairment of want memory in the face of normal adjustments to other aspects of the test situations.

Impairment of intellectual ability, as shown by poor judgment and frequent mistakes pertaining to business, is the second most frequent finding. A change of personality was noted in twenty-four patients, characterized in some by emotionalism, irritability, euphoria, witzelsucht, indifference or some insidious feature that is apparent to the family but not easily described.

As to changes in personality, Schwab[9] gave an interesting analysis and proposed the recognition of four main heads. A study of personality may include (1) physical traits, (2) physiologic traits, (3) psychic traits and (4) a group of traits to cover which he used the word flavor. By studying personality from these four angles one can find a standard of comparison either for the period before the change in personality was noted or in successive stages during the progress of the disease. In the physiologic traits he included the mechanism of action and the strength and tone relations of responses; in the psychic traits he included speech, memory, understanding, imagination, judgment, appreciation and the capacity to arrive at conclusions and deductions from a set of observations, and in the last group were included the general impression that the personality makes, such as a pleasing, disagreeable, revolting, suspicious or charming impression.

Childishness, though not as frequent as some of the other symptoms (there were but six instances in our series), is significant when present. The patients react in all respects like children. Euphoria and witzelsucht may be considered together. When present they are so easily recognized that they cannot escape the examiner, and for this reason they have always impressed me as perhaps the most telling of all the phenomena associated with tumor of the frontal lobe. By euphoria is implied a state of mind in which the patient is always contented, no matter what reason there may be for discomfiture. He has no realization and is in no

8. Jacobsen, C. F.: Functions of Frontal Association Area in Primates, Arch. Neurol. & Psychiat. **33**:558 (March) 1935. (The quotation cited is from the author's abstract of this paper.)

9. Schwab, S. I.: Brain **50**:480 (Oct.) 1927.

way aware of the seriousness of his condition. Nothing seems to disturb him. Witzelsucht, a term borrowed from the German tongue, is equally characteristic. It implies a tendency on the part of the patient to make light of everything. There were in our series nine illustrations of this. However, this characteristic has been observed in cases of tumor in other locations and is considered by some as unreliable.

Disorientation, most often as to time, place or person, was noted in seventeen patients. Pierre Marie [10] called attention to spatial disorientation as a sign of tumor of the frontal lobe. In some instances this may be a striking symptom, but it does not always indicate the presence of a tumor of this region. We had one patient with a lesion of the brain stem and secondary hydrocephalus in whom spatial disorientation was a striking symptom. This man could not find his room in his own house and would often urinate in one of the bedrooms instead of in the toilet.

Baruk [11] stated as his opinion that disorientation is due to a disturbance of the relation between the labyrinth and the visual apparatus. The patient frequently makes mistakes in the movements of the body; when told to turn right he may turn left. Spatial disorientation, which was conspicuous in three of our patients, is said to be associated with deep-seated lesions, particularly when a whole lobe or both lobes are involved. In fact, Marie and Béhague [12] attributed this symptom to a lesion of the cingulum and fasciculus unciformis.

Filthy habits and slovenliness were outstanding symptoms presented by two of our patients. One man, with a large fibroblastoma of at least four years' duration, though he had been well bred and refined, began to speak coarsely after the onset of the illness and made vulgar remarks and indulged in lewd stories and unprovoked profanity. Another man, with an astrocytoma of the left frontal lobe, used obscene language and often urinated in the presence of strangers.

In the question of differential diagnosis as it relates to psychic symptoms, one must remember that the mental picture may resemble that in cases of dementia paralytica.

Aphasia.—Should the tumor involve the left inferior frontal convolution in a right-handed subject, obviously true motor aphasia may be one of the localizing phenomena. It so happened in this series of one hundred and five cases that true aphasia was observed in seven patients (6.9 per cent). In Kolodny's [4] series of thirty cases of tumor, aphasia was observed in eight of seventeen patients (29 per cent) with

10. Marie, Pierre; Bouttier, H., and Van Bogaert, L.: Rev. neurol. **2**:209 (Sept.) 1924.

11. Baruk, H.: Encéphale **21**:760, 1926.

12. Marie, Pierre, and Béhague, P.: Rev. neurol. **35**:3, 1919.

tumor of the left frontal lobe; in Sachs'[5] series ten of the fifteen patients with tumor of the left frontal lobe and three of the ten patients with tumor of the right frontal lobe (26 per cent) were aphasic. Vincent[13] reported thirteen cases of aphasia in his series of twenty-five cases: ten in fifteen cases of tumors on the left side and three in ten cases of tumors on the right side.

One must be careful to differentiate true aphasia from such disturbances of speech as may be due to the slow cerebration associated with an increased intracranial pressure or the defective memory that may be associated with a tumor of the frontal lobe. Hesitancy of speech, or bradyphasia, must not be mistaken for true aphasia. As Kolodny said, "The patient wanders off repeatedly and loses the thread of his narrative, when constantly prompted his emissive speech appears normal." According to the location and the direction in which the tumor is growing, aphasia may be an early or a late symptom. In one of our cases, in which a fibroblastoma was removed four years after the onset

TABLE 2.—*Incidence of Various Signs of "Frontal Ataxia"*

	Number of Cases
Staggering gait	24
Romberg sign	23
Dyssynergia	20
Dysdiadokokinesia	17
Dysmetria	11
Nystagmus	9

of the illness, the patient, a clergyman, experienced difficulty in the deliverance of his sermons because of mistakes in the use of words. In cases of tumor of the frontal lobe there are no signs of sensory aphasia; the speech defects are essentially those of emissive speech.

Ataxia.—The term "frontal ataxia" was applied by Bruns[14] to the symptoms and signs of tumor of the frontal lobe as contrasted with the ataxia associated with a cerebellar tumor. One or more signs of ataxia were observed in 49 per cent of our patients (table 2 gives the frequency of each).

When the tumors are classified pathologically (as fibroblastomas, astrocytomas, glioblastomas and other gliomas) there is no great difference in the incidence of ataxia in association with the various types.

When the cases of fibroblastoma were subdivided according to the location, it was found that ataxia had been observed in thirteen cases in which the tumor occupied the superior lateral aspect, in one case of tumor of the sphenoid ridge and in no case of tumor of the olfactory

13. Vincent, C.: Rev. neurol. **1**:801, 1928.

14. Bruns, L.: Deutsche med. Wchnschr. **18**:138, 1892.

groove or of both frontal poles. Signs of ataxia were present in thirteen of fifteen cases of fibroblastoma (86 per cent) occupying the superior lateral surface of the hemisphere anterior to the fissure of Rolando, but ataxia was present in only one of the twenty-one cases of fibroblastoma (5 per cent) of the sphenoid ridge, of the olfactory groove or of both frontal poles. Ataxia was a prominent feature in six of the fifteen cases and was present to a lesser degree in seven others. The signs were bilateral in nine, contralateral in three and ispilateral in one (this patient had ipsilateral paresis). In discussing the varied distribution of ataxia as to laterality, Hughlings Jackson said that if the pathways on one side may assume the function of those on the other it is difficult to understand why in so many cases the symptoms are unilateral. If both tracts were involved by the pressure of a midline tumor, one would expect the signs of cerebellar dysfunction to be bilateral; our records show that this was seldom the case. Many writers have expressed the belief that the ataxia caused by a tumor of the frontal lobe is a distant effect. Brun,[15] however, combined the two points of view, postulating the existence of two forms. The one is severe in type, is bilateral from its onset and appears in the terminal stages, being due to massive pressure in the anteroposterior direction on the posterior cranial fossa. The other appears early, is unilateral and often contralateral and results from involvement of the frontopontile pathway.

Though a number of papers discussing "frontal ataxia" have appeared in the last few years, only those having a direct bearing on our material will be quoted. Several explanations for "pseudocerebellar" signs in cases of supratentorial tumor have been offered. Purves-Stewart [16] and many writers have attributed them to pressure exerted diagonally on the contralateral cerebellar hemisphere. Grant [17] invariably observed evidence of greatly increased intracranial pressure in his series of cases, and the cerebellum was crowded into the posterior fossa and squeezed between the pressure from above and the base of the posterior fossa beneath. Grant stated that he also considered the possibility that herniation of the base of the cerebral hemispheres through the incisura tentorii might result in compression of the superior cerebellar peduncles, with resulting "cerebellar signs." Since most of the studies of "frontal ataxia" have been made in patients with tumor, the factor of pressure cannot be readily dismissed. However, the most widely supported view is that this type of ataxia is the result of interference with the func-

15. Brun, R.: Ztschr. f. d. ges. Neurol. u. Psychiat. **138**:122, 1932.

16. Purves-Stewart, James: Intracranial Tumors and Some Errors in Their Diagnosis, London, Oxford University Press, 1927.

17. Grant, F. C.: Cerebellar Symptoms Produced by Supratentorial Tumors, Arch. Neurol. & Psychiat. **20**:292 (Aug.) 1928.

tion of the frontopontocerebellar pathways. A striking illustration of this type of ataxia was observed in a child aged 3 years, and the correct localization was not even suspected until the ventriculogram was made.

CASE 7.—*History.*—R. R., a girl aged 3 years, was admitted to the neurosurgical service on Jan. 31, 1928, because of clumsiness and swelling of the head. The birth and family histories were without significance. About a year before admission to the hospital the child stumbled frequently in running and was unable to keep up with younger children in play. This clumsiness seemed limited to the left side. Soon after that the mother became aware that the child's head was abnormally large. Two months before admission the child began complaining of headache and became restless and irritable. A month later, while standing, she became stiff and pale, though she did not fall or appear to lose consciousness. She had another similar attack the same day and a third four days before entering the hospital. There had been no convulsive seizures. After the third attack the child had some difficulty in walking and was unable to walk up stairs except by holding on to the railing.

Examination.—The child was intelligent but restless, groping at any object that attracted her attention. The head was enlarged, especially in the biparietal diameter, and the left temporal region appeared depressed. Both fontanels were closed. The veins of the scalp were prominent.

Because of the child's age it was difficult to apply the usual tests, but by careful observations for a week the following facts were noted: In smiling the left corner of the mouth was not innervated, yet when the child was asleep the right eye remained partly open. She was unsteady when standing with the feet together or separated, and the gait was unsteady. She usually used the left hand in preference to the right, but the right arm was not paralyzed and at times was used without greater incoordination than the left. Often ataxia was more prominent in performing the finger-to-nose test with the right hand than with the left.

The right patellar reflex was hyperactive and the left diminished, but the plantar responses were normal.

Vision did not appear to be seriously impaired. There was 1 diopter of choking in each disk, with evidence of postpapillitic atrophy.

Roentgenogram: There was evidence of increased intracranial pressure, as indicated by convolutional atrophy, widening of the sutures and enlargement of the skull and of the sella turcica.

Since there was some question as to localization, a ventricular estimation was made on February 13 and revealed that the left ventricle was enlarged and the right ventricle collapsed.

On March 3 a ventriculogram revealed a greatly dilated left lateral ventricle, with displacement to the left. The entire anterior part of the right lateral ventricle was obliterated (fig. 18).

Operation (March 3).—The ventriculogram unquestionably eliminated the possibility of a cerebellar lesion and localized the lesion in the right frontal lobe. A flap was reflected in the right frontoparietal region. The dural tension was extreme. A firm tumor was exposed which occupied almost the entire right frontal lobe (fig. 19). The dura was adherent to the tumor. Because of the tremendous size of the tumor and the age of the patient it was decided not to attempt removal at that sitting. In spite of the limitation of the first intervention, the child died early the following morning.

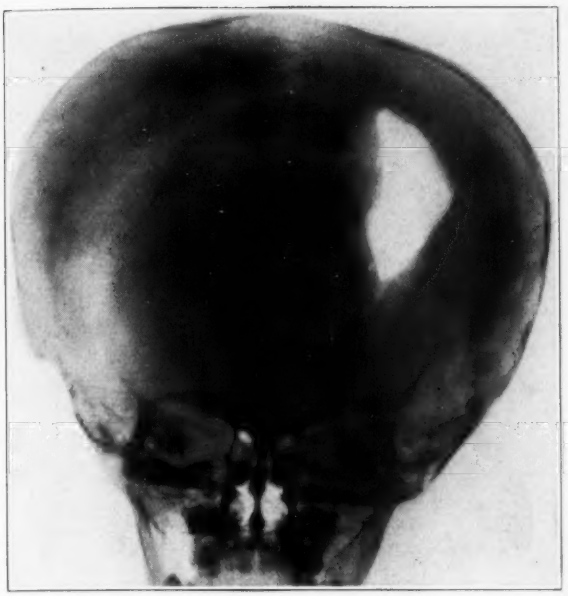

Fig. 18 (case 7).—Roentgenogram showing the tremendous hydrocephalus and the obliteration of the anterior horn of the right lateral ventricle.

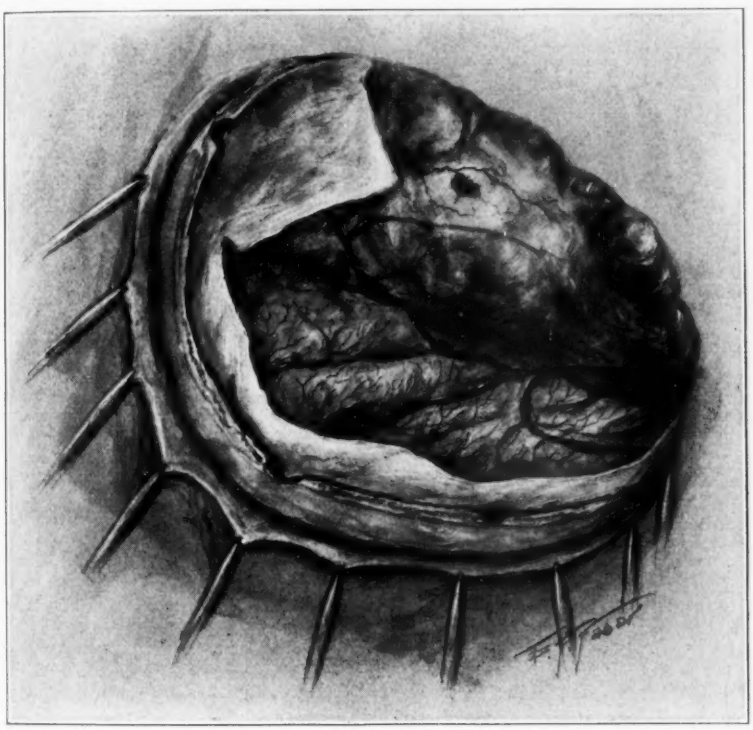

Fig. 19 (case 7).—Sketch made at operation of a huge tumor of the right frontal lobe, a meningeal fibroblastoma.

Autopsy.—A huge tumor of the frontal lobe, weighing 230 Gm., occupied both anterior fossae. In the neighborhood of the right uncinate gyrus was a small subcortical cyst projecting toward the interpeduncular space. The tumor was firm and encapsulated and had both the gross and the microscopic characteristics of a meningeal fibroblastoma (fig. 20).

For a century "crossed cerebellar atrophy," atrophy of one cerebellar hemisphere associated with atrophic changes in the opposite cerebral hemisphere, has been recognized (Demole [18]). However, this type of atrophy was demonstrated experimentally for the first time in 1895,

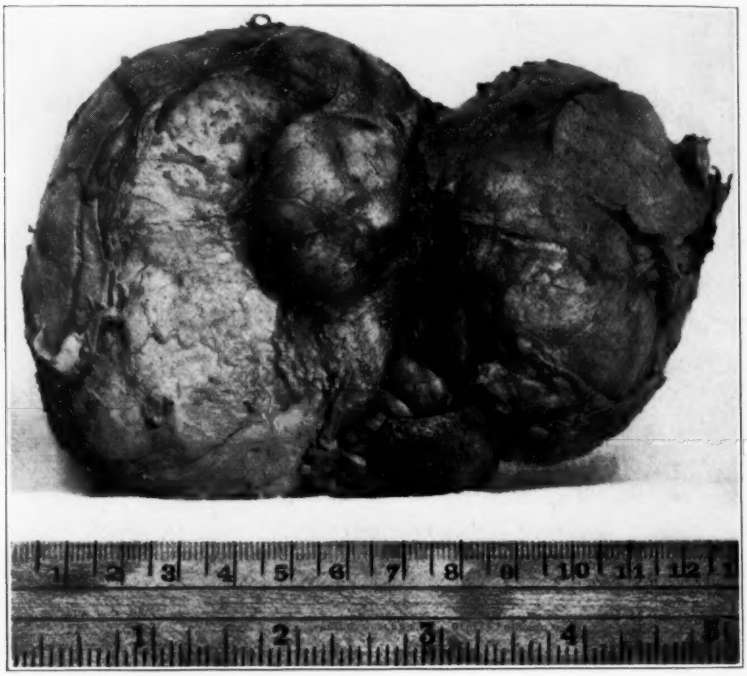

Fig. 20 (case 7).—Photograph showing the brain and tumor with the deep excavation formed by the tumor in both frontal lobes.

when von Monakow [19] removed a portion of the cerebral hemisphere of a young dog and of a new-born cat. In 1912 Kononova [20] described cases of lesions in the cerebral hemisphere acquired during adult life associated with crossed atrophy of the cerebellum. Now it is generally

18. Demole, V.: Schweiz. Arch. f. Neurol. u. Psychiat. **20**:271, 1927.

19. von Monakow, cited by Demole.[18]

20. Kononova, Elisabeth: L'atrophie croisée du cervelet consécutive aux lésions cérébrales chez l'adulte (étude anatomopathologique), Thèse de Paris, no. 142, 1912.

accepted by anatomists that the first neuron of the corticopontocerebellar pathway arises in the cortex of the frontal lobe, passes by way of the internal capsule and basis pedunculi to end about the pontile nuclei (Addison,[21] Ranson [22] and Huber [23]). Which areas of the frontal cortex contain the cells giving origin to these neurons does not appear to be known. The second neuron passes from the pontile nuclei to end in the cortex of the opposite cerebellar hemisphere.

There is physiologic evidence indicative of a corticocerebellar relationship, but just what influence the cortex exercises on the cerebellum is not entirely clear. It has been shown by earlier workers (Demole [18]) that removal of one cerebellar hemisphere produces signs of cerebellar dysfunction in the ipsilateral extremities. If the animal is allowed to recover function, injury to the contralateral frontal lobe in the region of the sigmoid gyrus causes reappearance of the signs of cerebellar involvement. In 1932, by making lesions in the prefrontal region in dogs, Delmas-Marsalet [24] produced crossed hypotonia and ataxia which persisted until the animals were killed several months later.

In the monkey the motor, premotor or prefrontal area may be extirpated unilaterally or bilaterally, and after a few days, when the immediate postoperative effects have disappeared, no signs resembling cerebellar ataxia are present.[25] However, Fulton and Kennard [26] have noted that a premotor preparation may exhibit ataxia when very excited. Fulton and Aring [27] have found that contralateral ablations of the premotor area cause an increase in the signs of cerebellar deficit in monkeys in which the cerebellar peduncles have been sectioned unilaterally. Contralateral extirpation of the motor area appears to decrease these signs, and this is marked until some motor power returns.

Bruns,[14] who coined the term "frontal ataxia," expressed the belief that these signs are caused by an interference with the pathways con-

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21. Addison, W. F., in Villiger, E.: Brain and Spinal Cord, ed. 3, Philadelphia, J. B. Lippincott Company, 1925.

22. Ranson, S. W.: The Anatomy of the Nervous System, ed. 2, Philadelphia, W. B. Saunders Company, 1925.

23. Huber, G. C.: Piersol's Human Anatomy, ed. 9, Philadelphia, J. B. Lippincott Company, 1930.

24. Delmas-Marsalet, P.: Rev. neurol. **2**:617, 1932.

25. Watts, J. W.: Personal communication to the author.

26. Fulton, J. F., and Kennard, Margaret A.: A. Research Nerv. & Ment. Dis., Proc. **13**:158, 1932.

27. Aring, C. D., and Fulton, J. F.: Relation of the Cerebrum to the Cerebellum: II. Cerebellar Tremor in the Monkey and Its Absence After Removal of the Principal Excitable Areas of the Cerebral Cortex (Areas 4 and 6a, Upper Part); III. Accentuation of Cerebellar Tremor Following Lesions of the Premotor Area (Area 62, Upper Part), Arch. Neurol. & Psychiat., to be published.

necting the frontal lobe and the cerebellum. Puusepp [28] stated that ataxia was more marked in cases of deep-seated tumor, especially of a tumor lying between and pressing on both frontal lobes. In 1931 Hare [29] reported four verified cases of tumor of both frontal lobes and emphasized the importance of bilateral involvement in the production of ataxia. This hypothesis was strongly supported by his review of the literature. Three years later Gordon [30] described five verified cases of unilateral lesions of the frontal lobe in which there were definite signs of ataxia and in which there was little possibility of involvement of the opposite frontal lobe. The literature assembled by Gordon supported his expressed belief that definite ataxia is produced by a unilateral lesion even in the absence of evidence of increased intracranial pressure.

This statement that ataxia may be caused by a unilateral or a bilateral tumor of the frontal lobe even in the absence of signs of increased intracranial pressure seems to admit of no contradiction. In our series the incidence of ataxia was many times greater in cases in which the tumor occupied the superior and lateral aspects than in cases in which it had its origin at the base of the skull, in the frontal poles or within the brain (glioma). It is probable that the high incidence of ataxia in the cases of parasagittal fibroblastoma is accounted for by damage to the cells giving origin to the frontopontocerebellar system, and it is suggested that many of the cells of origin of the frontopontocerebellar system may lie in the intermediate zone.

Regardless of the explanation, some form of ataxia is frequently present in patients with a tumor of the frontal lobe. Therefore, when ataxia is noted in association with signs suggestive of tumor of the frontal lobe, the presence of ataxia may be considered of confirmative value. Even when the ataxia is marked, a differential diagnosis can usually be made between a cerebellar tumor and a tumor of the frontal lobe by a careful evaluation of the associated symptoms and signs. However, in a small proportion of cases a ventricular estimation or a ventriculogram may be requisite.

Incontinence.—In this series of cases of tumor of the frontal lobe urinary incontinence was present in nineteen, and urinary disturbances of other kinds were noted in six additional, cases. Although incontinence might have been attributed to aphasia, indifference or other mental changes in some patients, it did not appear to explain this symptom in others. Often a patient was rational, well oriented and without signs of mental deterioration and yet never asked for a urinal, and the bedclothes had to be changed several times a day. One patient did not seem

28. Puusepp, L.: Presse méd. **33**:1201, 1925.
29. Hare, C. C.: Bull. Neurol. Inst. New York **1**:532, 1931
30. Gordon, A.: J. Nerv. & Ment. Dis. **79**:411, 1934.

to know that he had voided until he became aware of his wet clothing. Another, when asked why he had voided in bed, replied that he had to urinate and could not wait.

A possible explanation became apparent when urinary incontinence was considered in the light of our studies on the relation of the cerebral cortex to the gastro-intestinal movements and sensation. Our investigations (Watts and Uhle;[31] Frazier, Watts and Uhle[32]) have demonstrated that vesical dysfunction (neurogenic dysfunction comparable to that observed in cases of lesion of the spinal cord) may be caused by an intracranial tumor, presumably owing to a disturbance of the autonomic representation of the bladder in the brain.

Neurogenic dysfunction of the bladder associated with disease, injury or developmental defects of the spinal cord is well known by its clinical symptoms and the cystoscopic picture. In recent years much has been added to the knowledge of this type of vesical dysfunction as a result of the investigations of Rose,[33] Holmes[34] and Denny-Brown and Robertson[35] by comparison of the volume-pressure relationship when fluid is slowly run into the bladder. In our clinical tests vesical pressure is recorded in millimeters of mercury.[36] Increasing amounts of fluid are run slowly into the bladder through a catheter, and the pressure is recorded after each 50 cc. is introduced. A record is made (1) of the capacity at which the patient has the first desire to void, (2) of the first sensation of discomfort, (3) of the first pain and (4) of any leakage that occurs about the catheter.

Eleven patients with tumors in various parts of the brain were examined (two with a tumor in the frontal lobe, three in the fronto-temporal lobe, one in the temporal lobe, one in the parietal lobe, one in the corpus callosum, two in the diencephalon and one in the cerebellopontile angle). Patients with a hypertonic curve gave a history of urgency and periodic involuntary urination. Two patients with hypotonic curves had difficulty of urination for several months, followed by retention requiring catheterization. The six other patients, all of whom had hypotonic curves, had no urinary symptoms. Without

31. Watts, J. W., and Uhle, C. A. W.: Cystometric Determinations of Intravesical Pressure in Patients with Tumor of the Brain: A Preliminary Report, Arch. Neurol. & Psychiat. **34**:224 (July) 1935; J. Urol. **34**:10, 1935.

32. Frazier, C. H.; Watts, J. W., and Uhle, C. A. W.: Source of Visceral Impulses, A. Research Nerv. & Ment. Dis., Proc. **15**:239, 1935.

33. Rose, D. K.: Determination of Bladder Pressure with the Cystometer: A New Principle in Diagnosis, J. A. M. A. **88**:151 (Jan. 15) 1927.

34. Holmes, G.: Brain **56**:383, 1933.

35. Denny-Brown, D., and Robertson, E. G.: Brain **56**:397, 1933.

36. Muschat, M., and Johnston, C. G.: J. Urol. **27**:273, 1932.

going further into this discussion, suffice it to say that there is considerable experimental evidence pointing to an influence exerted by the cerebral cortex over the urinary bladder and that it has been shown that stimulation of certain portions of the cerebral cortex leads to vigorous contraction of the bladder with emptying of its contents. Section of the brain stem also alters the function of the bladder, and a hypertonic bladder results, depending on the level of the section.

Observations on our patients with tumor of the brain and the experimental evidence already given led us to the conclusion that vesical dysfunction in a patient with a tumor of the brain is probably the result of a disturbance of the representation of the bladder in certain parts of the brain or of tracts descending from them. Until further observations have been made, no attempt will be made to state where this representation is seated. However, the high incidence of dysfunction of the bladder in patients with tumor of the frontal lobe suggests that the frontal lobes must exercise some degree of influence. Whether hypotonicity of the bladder indicates a lesion in one part of the brain and hypertonicity a lesion in another part is an interesting problem for further investigation.

Morbid Hunger.—Excessive appetite, which made its appearance at the onset or during the course of the illness, was a prominent symptom in three of our patients. In two cases it was associated with great thirst. When a patient with symptoms of brain tumor eats the usual meals and then constantly clamors for food, the condition is striking. The histories of two patients with these symptoms are given briefly.

Case 8.—*History.*—E. D., a woman aged 28, was admitted to the neurosurgical service on Sept. 23, 1929, with a history of increased intracranial pressure, a voracious appetite, an inordinate thirst and urgency and frequency of urination. Two months before admission, when she had been pregnant for seven months, there developed severe headache in the occipital region and vomiting. The infant was delivered, but the headache and vomiting continued. In the latter part of August 1929 vision began to fail; the patient appeared irrational at times and complained of numbness of the right arm and leg. The appetite became voracious and thirst inordinate. The patient drank large quantities of water, but she complained that her throat always felt dry. About 4 ounces (120 cc.) of urine was voided every half-hour, and the patient complained of dysuria.

Examination.—The patient was uncooperative, complained continually of pain in the head and neck and asked repeatedly for water. She was completely blind, and there were bilateral choked disks, with atrophy of the optic nerves. There was paresis of both external rectus muscles. Smell and taste were greatly diminished. The tendon reflexes could not be obtained. Bulimia and polydipsia were very striking. The patient drank 5,000 cc. of fluid a day and continually asked for water. She voided every half-hour and unless a receptacle was immediately available voided in bed; in spite of precautions the bedclothes had to be changed

several times a day. The urine was normal; the specific gravity was 1.010. The results of the sugar tolerance test were as follows:

	Blood, Mg.	Urine
After fasting	117	Negative
One-half hour after dextrose	158	Negative
One hour after dextrose	194	Trace
Two hours after dextrose	225	Negative

Course.—Bulimia and polydipsia persisted until within a few days of death, and periodic urination lasted until the end. The patient died on October 8.

Autopsy.—Autopsy revealed a fairly well circumscribed astrocytoma, 8 by 6.5 by 6 cm., in the left frontal lobe. It occupied the superior frontal convolution,

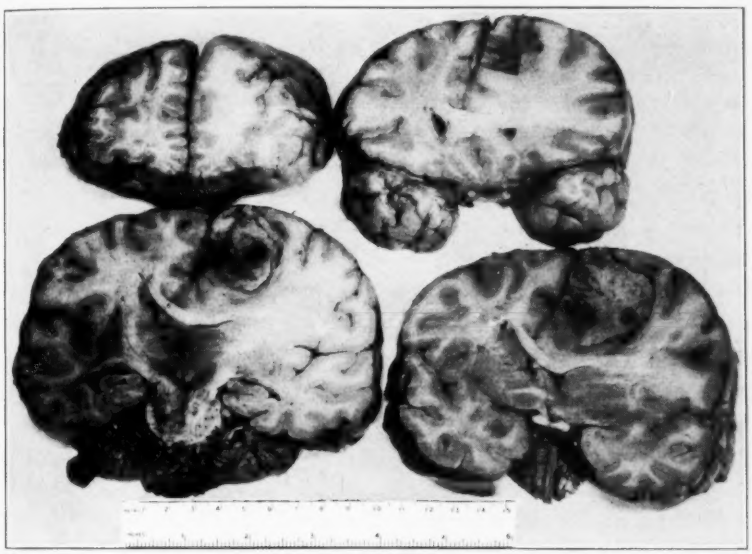

Fig. 21 (case 8).—Photograph showing a fairly well circumscribed astrocytoma of the left frontal lobe.

lay adjacent to the falx cerebri mesially and encroached on the lateral ventricle and the corpus callosum. The pituitary gland was enlarged, measuring 18 by 12 by 10 mm. (fig. 21).

The bladder was contracted and empty. The mucosa showed no congestion, and it was considered unnecessary to cut sections for microscopic study.

Case 9.—*History.*—H. S., a man aged 49, was admitted to the neurosurgical service on Oct. 29, 1934, complaining of headache and loss of vision. In May he felt weak, had lost all energy and became aware of an increase in appetite. He had always had a good appetite, eating as much as 2 pounds (900 Gm.) of steak and 4 pounds of potatoes (1,800 Gm.) at a meal, but since the onset of the illness he had often eaten 3 pounds (1,300 Gm.) of steak and 6 pounds (2,700 Gm.) of potatoes. The headaches were first observed in August, and in the following

month vision began to fail. Since September 14 the patient had been bedridden; vision had failed rapidly, and he had had four attacks of vertigo.

Examination.—The patient appeared somewhat somnolent, but when aroused he was cooperative, euphoric and talkative. There were bilateral choked disk of 3.5 diopters, left homonymous hemianopia with involvement of the right macula and slight weakness of the left side of the mouth. With a dynamometer the grip was 130 with the right hand and 80 with the left. The feet were held far apart in walking, and the patient tended to fall to the left. Roentgenograms of the skull showed the pineal body displaced to the left. A cystometric determination revealed a definitely hypotonic bladder, the details of which are given elsewhere.

Operation.—A large subcortical glioma infiltrating the right frontal and temporal lobes was exposed and partly removed. The patient was discharged from the hospital on November 28, somewhat improved.

Pathologic Diagnosis.—Histologically the tumor was a glioblastoma multiforme.

Course.—After leaving the hospital the patient gained 17 pounds (7.7 Kg.) and felt entirely well. On March 13, 1935, he was readmitted for a course of roentgen therapy. At that time he was talkative and euphoric, there was left homonymous hemianopia; visual acuity was 6/22 in the left and 6/60 in the right eye. The grasp was weaker with the left hand than with the right. After a course of roentgen therapy had been given the patient was discharged with the neurologic status unchanged.

The details of a third case of excessive hunger and thirst were given in case 5.

In 1887 Mills[37] reported two cases of tumor of the brain and pointed out that the upper as well as the lower branches of the facial nerve may be paralyzed by a cortical lesion. One of his patients, a boy aged 16, fell from a chair and vomited and during the next few days had headache, diplopia, sensations of choking and weakness of the left arm which progressed to hemiplegia with complete facial paralysis. After the first week the patient became ravenously hungry and bolted his food at all times. Bulimia persisted until death, which occurred a week after the appearance of this symptom. Autopsy revealed a tumor adherent to the dura mater, presenting at the posterior part of the second frontal convolution. The greatest diameter of the tumor was 2½ inches (6.4 cm.).

Cases of morbid hunger following injury to the brain have been described by Paget,[38] Bechterew[39] and Sollier and Delagénière.[40] One of the cases referred to by Bechterew was that of a child who sustained a depressed fracture in the midfrontal region. When she recovered consciousness she cried constantly that she wanted more food. Bulimia

37. Mills, C. K.: J. Nerv. & Ment. Dis. **14**:707, 1887.

38. Paget, S.: Tr. Clin. Soc. London **30**:113, 1897.

39. von Bechterew, Vladimir: Die Functionen der Nervencentra, ed. 3, Jena, Gustav Fischer, 1911.

40. Sollier, P., and Delagénière, H.: Rev. neurol. **9**:1103, 1901.

continued for four days after the splinters of bone had been removed from the frontal region. The frontal lobe also was involved in the case of Sollier and Delagénière.

In 1909 Spiller [41] reported a case of glioma of the pons in which intense hunger was a prominent symptom and remarked that he had observed two other patients with tumor of the brain who had enormous appetites. It was Spiller's impression at that time that the location of the tumor was not significant in relation to the production of excessive hunger. Recently, two cases of cerebral trauma in which bulimia was marked were reported by Brouwer,[42] and a case of tumor of the frontal lobe in which this symptom was present was reported by Watts.[43]

Little significance could be attached to these isolated reports until Fulton, Jacobsen and Kennard [44] observed that monkeys after removal of both frontal areas ate several times as much as normal animals. Thinking that the ravenous appetite might be due to some metabolic disturbance, Bruhn [45] studied the basal metabolic rate of these animals as well as of normal monkeys. His results soon made it apparent that, in spite of their excessive appetites and activity, these animals had a normal basal metabolic rate. However, he found that the basal metabolic rate might be elevated after extirpation of both premotor areas, presumably owing to spasticity of the extremities. Recently, in discussing morbid hunger Fulton [46] suggested that the symptoms of morbid hunger might be due to increased motility of the stomach, and Watts [43] added that it might be the result of the fact that food is hurried through the alimentary canal at a rate which does not allow time for adequate digestion and absorption.

Motor and Reflex Changes.—Epileptiform seizures were noted in forty-four patients (40 per cent). There were generalized convulsions in seventeen, and in sixteen others the convulsive attacks had a focal distribution. Six patients had attacks of unconsciousness not associated with convulsive movements, and three had petit mal. When the cases were classified according to the histopathologic picture of the tumors, the percentage of epileptiform attacks did not differ strikingly in the various groups (fibroblastoma, 35 per cent; astrocytoma, 44 per cent;

41. Spiller, W. G.: Brain Tumor, J. A. M. A. **53**:2078 (Dec. 18) 1909.

42. Brouwer, B.: Klinische demonstratie van organische zenuwziekten, voordracht gehouden in de vergadering van de geneeskundige Kring te Amsterdam, October 1934.

43. Watts, J. W.: The Influence of the Cerebral Cortex on Gastro-Intestinal Movements, J. A. M. A. **104**:355 (Feb. 2) 1935.

44. Fulton, J. F.; Jacobsen, C. F., and Kennard, Margaret A.: Brain **55**: 524 (Dec.) 1932.

45. Bruhn, J. M.: Am. J. Physiol. **110**:477 (Dec.) 1934.

46. Fulton, J. F.: J. Michigan M. Soc. **33**:175, 1934.

glioblastoma, 50 per cent, and other gliomas, 38 per cent). In his series of two hundred and ninety-one cases of meningeal tumor, Groff [47] noted epileptiform seizures in 30.9 per cent, about the same percentage of convulsions that other authors have found in cases of tumor of other types. Groff noted the incidence of seizures to be greatest in cases of tumor of the frontal, parietal or temporal lobe; thus eighty of the one hundred and sixteen patients with tumor of this type had convulsions.

Of our series of sixteen patients with focal attacks, in three, the seizures started in the face, in three in the arm and in three with a turning of the head and eyes. In nine patients the attack appeared to start in the arm and leg of the contralateral side almost simultaneously. In only one did the convulsion begin in the leg.

A study of the relation of the site of the tumor to the convulsions revealed that no focal convulsive attacks, exclusive of uncinate attacks, occurred in patients with fibroblastoma of the olfactory groove, sphenoid ridge or frontal pole. One patient with a fibroblastoma of the olfactory bulb had generalized convulsions. Although attacks of unconsciousness without convulsions occurred only six times, one instance was in a case of tumor of the sphenoid ridge and another in a case of fibroblastoma of the olfactory groove. The parasagittal fibroblastomas and the gliomas caused focal and generalized convulsions with about the same frequency, and one can only say that convulsions caused by tumor of the frontal lobe rarely begin in the leg.

Hemiparesis was present in twenty-six patients (associated with facial weakness in seven). Facial weakness alone was noted in nine patients and weakness of the face and arm in three. Thus, facial weakness was present in nineteen of our patients (18 per cent). It is difficult to correlate these results with those of Sachs,[5] who noted facial weakness in thirty-two of forty-five patients with tumor of the frontal lobe (70 per cent), and in fifteen of these there were no other motor phenomena. So, too, it is difficult to account for this wide discrepancy between our statistics and those of Sachs. Not only is it difficult, but if our statistics correspond more closely with those of other observers, Sachs' conclusions would be misleading. In fact Sachs considered facial weakness as one of the four most suggestive localizing symptoms, with mental change, convulsions and nystagmus the other three. The greater incidence of facial paresis, as compared with other motor phenomena, he attributed to involvement of a special tract of fibers passing from the cortical face center. Vincent [13] also attached great importance to facial paralysis of the central type and linked it

47. Groff, R. A.: Ann. Surg. **101**:167 (Jan.) 1935.

with aphasia and mental symptoms in a syndrome which he said should be considered as characteristic of tumor of the frontal lobe.

Voris, Adson and Moersch [48] noted hemiparesis in one hundred and thirty-three (42 per cent) and facial weakness in one hundred and twenty (38 per cent) of their series of three hundred and fourteen cases of tumor of the frontal lobe, which included not only tumors which arose in the frontal lobe but also tumors which invaded the frontal lobe secondarily. However, when the forty-nine cases of tumor sharply localized in the frontal lobe were analyzed separately, hemiparesis was present in only fifteen (30 per cent) and facial weakness in only fifteen (30 per cent).

In thirteen cases of hemiparesis in our series the paretic extremities were spastic, and in four they were flaccid. The other nine patients presented so little alteration of posture or resistance to passive motion that neither the term spastic nor flaccid could be applied.

Tendon reflexes were greater on the paretic side in nine of the spastic patients, with a Babinski sign in six and ankle clonus in six (a contralateral Babinski sign in four and a bilateral sign in two; contralateral ankle clonus in two and bilateral clonus in four). The tendon reflexes were also greater on the paretic side in four of the patients with flaccid hemiparesis but equal on the two sides in one. The Babinski sign was present twice and ankle clonus twice.

The explanation of spasticity and flaccidity in patients with a cerebral lesion has concerned neurologists for many years. Light has been thrown on the subject by Fulton and Kennard [26] through a series of experiments on infrahuman primates. They have shown that extirpation of the motor area (area 4 of Brodmann) causes flaccid paralysis of the contralateral extremities, a Babinski response and diminution of the tendon reflexes. These signs become more pronounced after bilateral extirpation of area 4. A lesion restricted to the premotor area (area 6 of Brodmann) is followed by spastic paresis of the contralateral extremities, together with forced grasping, an increase in tendon reflexes, the Rossolimo response and fanning of the toes. These signs are present for a longer period after bilateral lesions than after a unilateral lesion of area 6. When areas 4 and 6 are both removed, marked spasticity and forced grasping appear. The extensor Babinski response becomes exaggerated, and the tendon reflexes are permanently exaggerated. From their experiments it was concluded that spasticity, forced grasping, the fanning sign and the Rossolimo tendon reflex of the digits point to lesions involving the premotor area or its projection system from the cortex, while flaccidity, the simple extensor Babinski response and

48. Voris, H. C.; Adson, A. W., and Moersch, F. P.: Tumors of the Frontal Lobe, J. A. M. A. **104**:93 (Jan. 12) 1935.

depression of the tendon reflexes suggest a lesion restricted to the pyramidal tract.

It is probable that spasticity and flaccidity in man likewise are related to lesions of the premotor and motor areas, respectively. However, as Fulton and Keller [49] have pointed out in the chapter of their book entitled "The Evolution of Cortical Dominance," the effects of comparable cortical lesions have somewhat different manifestations in the monkey and the chimpanzee; so they may differ correspondingly in the chimpanzee and man. This question is raised by our noting spastic hemiparesis in thirteen patients and flaccid hemiparesis in five. Seven of the thirteen patients with spastic hemiparesis had fibroblastomas—parasagittal and lateral, and six had gliomas—two subcortical, two presenting about the second frontal convolution, one in the basilar position of the frontal lobe and one occupying almost the entire frontal lobe. Three of the four patients with flaccid hemiparesis had a glioma occupying most of the frontal lobe, and a fourth had a glioma which presented at the third frontal convolution. Since the exact limits of the tumor cannot be readily defined, these findings do not form a serious objection.

The problem has been approached in man by Davison and Bieber,[50] who studied two groups of patients with hemiplegia—spastic and flaccid. Involvement of the premotor area was present in all the patients with spastic hemiplegia. In six patients with flaccid hemiplegia the premotor area also was implicated. In the first three of these six the degree of destruction was as marked as in any of the patients with spastic hemiplegia due to complete obstruction of the middle cerebral artery. The authors concluded that the premotor area may be involved without giving rise to spasticity and that the integrity of the premotor area is not solely responsible for the presence of flaccidity. Only careful observations on patients with sharply defined cortical lesions will determine whether one can apply to man the results of these experiments on monkeys and chimpanzees.

In two of our patients the hemiparesis was ipsilateral, and in both there was an encapsulated tumor near the frontal pole. Pick [51] reported on a patient with a tumor at the base of the frontal lobe who had a crossed paralysis, so that the tumor was believed to be in the pons. Kernohan and Woltman [52] studied a series of cases of tumor of the brain and came to the conclusion that notching of the crus cerebri by

49. Fulton, J. F., and Keller, A. D.: The Sign of Babinski, Springfield, Ill., Charles C. Thomas, Publisher, 1932.

50. Davison, C., and Bieber, I.: The Premotor Area: Its Relation to Spasticity and Flaccidity in Man, Arch. Neurol. & Psychiat. **32**:963 (Nov.) 1934.

51. Pick, F.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **14**:182, 1926.

52. Kernohan, J. W., and Woltman, H. W.: Incisura of the Crus Due to Contralateral Brain Tumor, Arch. Neurol. & Psychiat. **21**:274 (Feb.) 1929.

the free margin of the tentorium could explain the ipsilateral signs of involvement of the pyramidal tract in most of their cases.

Grasp Reflex.—I am assuming for the present that it is usually acknowledged that the grasp reflex must be elicited only by stroking the palm of the hand. With this interpretation only one grasp reflex was observed in our entire series (0.95 per cent).

CASE 10.—J. R., a man aged 45, entered the University Hospital in 1933 with a history of headache, vomiting and failing vision of two months' duration. On admission the patient was semistuporous. Both disks showed choking of 3 diopters. The right pupil was larger than the left. There was weakness of the left side of the face of the central type and slight weakness of the left arm. The tendon reflexes were more active in the left arm and leg, and there was bilateral ankle clonus. A definite grasp reflex was elicited when the palm of the left hand was stroked. The operation revealed a glioblastoma occupying the entire right frontal lobe.

I have observed bilateral forced grasping in two other patients, neither of whom had a primary tumor of the frontal lobe. A well defined grasp reflex could be elicited on one side in each patient by putting the tendons under slight stretch (but not by stroking the palm), and a similar though inconstant reflex could be obtained in the opposite hand.

CASE 11.—*History.*—P. M., a man aged 61, a patient of Dr. Spiller in August 1933, came under my observation on Sept. 18, 1933. At least a year before (September 1932) it had been noticed that there was something wrong with his golf stroke. Little attention was paid to this, but in February 1933 his associates noticed a gradually increasing lethargy and lack of initiation. He took a holiday at that time, and severe bilateral tinnitus developed. The roaring was like the sound of a locomotive and disturbed his sleep for several months. On returning from this trip in March he still complained of dizziness and vertigo but in addition of belching and flatus. By the middle of July he was forgetful and easily dropped off to sleep even in the middle of a conversation. Soon he had difficulty in moving the left leg; the gait was shuffling. In August he called attention to a quivering in both hands at times and observed that his left hand as well as his left leg was weak. Shortly before admission he had to be prompted to swallow; there was a diminished sense of smell on both sides and bilateral headache in the frontal region.

During the two weeks before admission to the hospital the patient voided involuntarily several times. The desire to urinate was followed by urination before he had time to reach the toilet. Intermittent twitching of the left side began nine days before he entered the hospital and appeared to be aggravated by excitement or strain. (Following the operation, before leaving the hospital, the patient told of an incident which he said embarrassed him considerably. About the middle of August, while performing an exploratory laparotomy, he grasped the appendix with his left hand and was unable to release it.)

Examination.—The patient was drowsy at times and alert at others. Attention was poor, memory for recent events was impaired and he was emotional, often breaking into tears when speaking about his family.

Motor Phenomena: There were definite weakness and spasticity of the left arm and slight weakness of the left leg. There were a marked tremor of the left hand, which was increased by effort, and some incoordination in complex movements.

Reflexes: All the tendon reflexes were hyperactive bilaterally, with positive Babinski, Rossolimo and Oppenheim signs on both sides. A grasp reflex was not observed when the palms were stroked, but when the palmar tendons of the left hand were put under slight stretch the fingers closed spasmodically and firmly over the object. The grasp could be released voluntarily but only after a few seconds of effort. The same was true, but to a less degree, of the right hand.

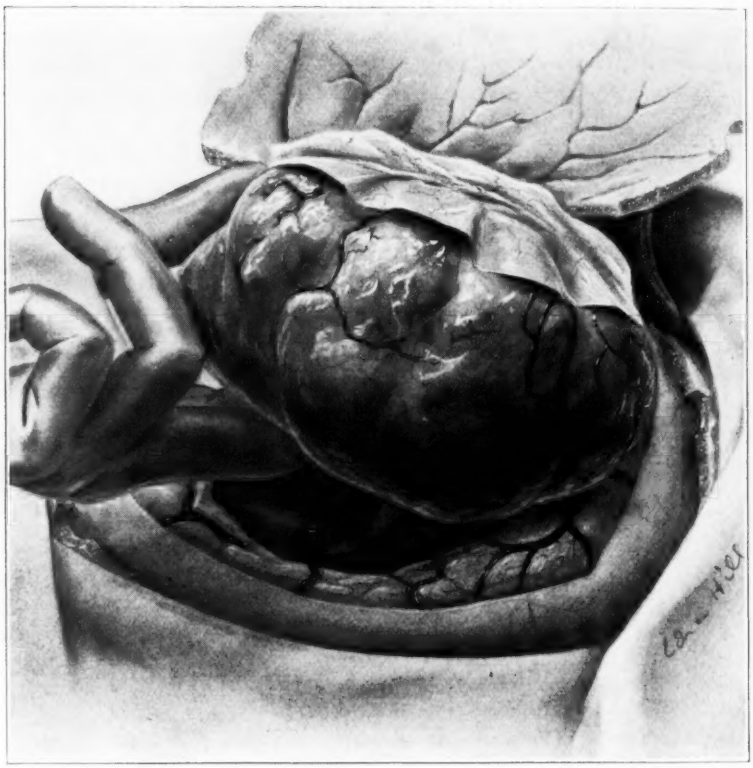

Fig. 22 (case 11).—Drawing made at operation, showing the encapsulated tumor of the frontal lobe.

Ophthalmic Examination: There were 3 diopters of choking in both optic disks and right homonymous defects in the visual fields.

Roentgenogram: The skull was normal, but there was evidence of disease of the sinuses.

Operation.—On Sept. 18, 1933, because the patient had an infected sinus a preliminary diagnosis of abscess of the frontal lobe was made, but exploration revealed no abnormality. However, when I saw the patient for the first time, twenty-four hours later, I was so impressed with the history of almost a year's duration that

I could not believe the symptoms could be due to anything but tumor. After waiting as long as I dared, an exploration was made on September 22—a transfrontal craniotomy on the right side. When the bone flap was reflected (Dr. Grant) there was an area of free oozing from the dura about the middle of the cranial opening. This was interpreted as due to an underlying tumor.

A circular incision was made in the dura around the boundaries of the tumor, and in this way the tension, which had been extreme, began to subside and the tumor to protrude. The contents of the tumor were scalloped out with the Bovie

Fig. 23 (case 11).—Photograph of the tumor, a meningeal fibroblastoma, after removal. It measured 11.5 by 8 cm.

loop; by that time the tumor had herniated beyond the level of the surrounding brain. It was encapsulated; the capsule was easily mobilized and finally was completely delivered (fig. 22). A few silver clips had to be applied beforehand to the vascular connections between the capsule and the brain. With the aid of two small muscle grafts a perfectly dry field was secured, and the operation was thus concluded.

Pathologic Diagnosis.—The tumor measured 11.5 by 8 cm. and proved to be a meningeal fibroblastoma (fig. 23).

Postoperative Course.—Convalescence was free from any disturbing features, and the patient was discharged from the hospital on October 14. Since that time he has resumed his former occupation and with the exception of one attack of unconsciousness has been free from symptoms.

This case well illustrates the difference between the true and what might be called the false grasp reflex, the latter being obtained by putting the tendons of the fingers on the stretch. The history is a perfect portrayal of a case of tumor of the frontal lobe. Particularly striking was the emotional imbalance, although by some this as well as the temperamental changes, which were equally outstanding, is not admitted as significant of dysfunction of the frontal lobe. But what might be easily passed over as in no way related to the tumor were the gastro-intestinal symptoms—the belching and flatus. So much has been written recently about cortical representation of the gastro-intestinal tract, in relation both to tumors and to epilepsy, that I wish to call attention especially to the digestive upset that developed in the course of this patient's illness.

Another illustration of a false grasp reflex may be found in the following case, reported in abstract.

CASE 12.—D. W., a man aged 64, was admitted to the urologic service because of incontinence. A month before he entered the hospital his family noted that he was acting queerly. Instead of taking half an hour for lunch he would take three hours. Twice he missed the bus which he had been taking regularly. He failed to answer questions addressed to him and on one occasion he wound a clock for three hours without stopping. He handled a knife and fork awkwardly, as if he were unfamiliar with their use. On Oct. 7, 1934, incontinence began. He wet himself periodically, but there was no dribbling between times.

The patient was uncooperative and showed no interest in questions about his illness. He answered a few simple questions correctly, but it was impossible to hold his attention. (The mental syndrome has been described in detail by Dr. Alpers.[53]) Speech was thick. There were weakness and spasticity of all the extremities, with exaggerated tendon reflexes. Often the patient was seen picking at the bedclothes or patting the bed for long periods. Stroking the palm excited no response, but *when the palmar tendons were put under slight tension a definite grasp reflex was elicited.* The grasp reflex was more constant in the left hand than in the right but could often be obtained in the right hand. Whether the grasp could be relaxed voluntarily, I do not know, as the patient had that attitude of detachment observed in cases of tumor of the corpus callosum and more often than not failed to obey commands.

The patient died about three weeks after entering the hospital, without an operation. Autopsy revealed a spongioblastoma confined almost entirely to the anterior third of the corpus callosum (fig. 24).

By many clinicians the grasp reflex, or forced grasping and groping, though only occasionally observed, has been associated exclusively with

53. Alpers, B. J.: J. Nerv. & Ment. Dis., to be published.

lesions of the frontal lobe. It was first observed by Janischewsky,[54] in 1909, in a complicated case in which there were "pseudobulbar symptoms." He attributed the reflex to a lesion of the frontal lobe, and a number of contributions have been made since then to confirm this

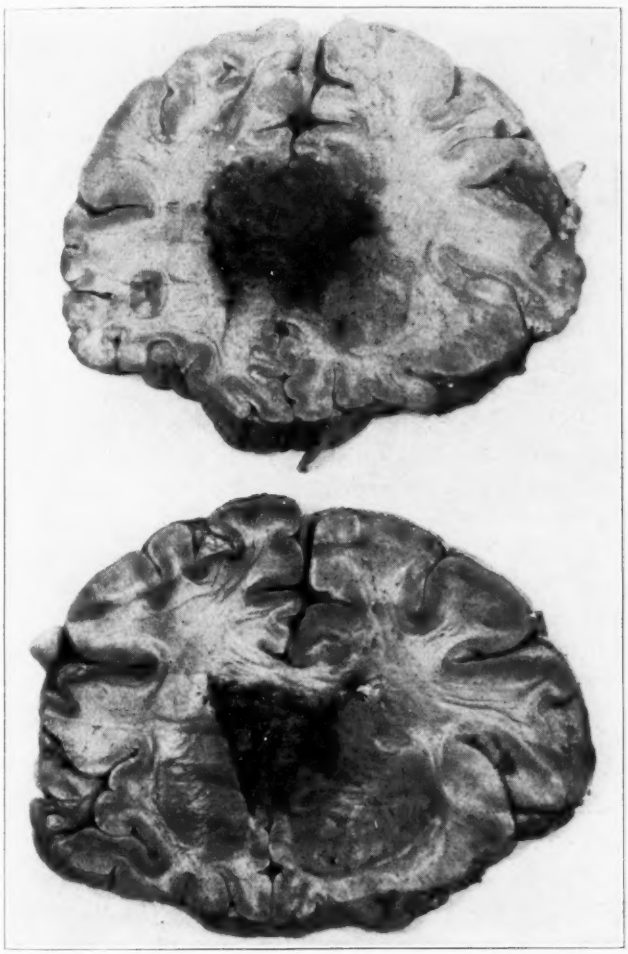

Fig. 24 (case 12).—Photographs of sections of the spongioblastoma of the corpus callosum.

opinion. A detailed description of the movements involved was given by Adie and Critchley,[55] who went so far as to say that the presence of the grasp reflex in a patient with a cerebral tumor is unequivocal

54. Janischewsky, A.: Rev. Neurol. **17**:823, 1909.

55. Adie, W. J., and Critchley, M.: Brain **50**:142 (June) 1927.

evidence of its situation in the frontal lobe. Bucy [56] reviewed two cases of tumor not of the frontal lobe in both of which there was bilateral reflex grasping. Contrary to the opinion of the majority, he stated the belief that the symptom has little localizing value in the presence of internal hydrocephalus, especially if it is bilateral. Mayer and Reisch [57] emphasized that the grasp reflex is not necessarily "forced," as implied in the term "forced grasping" (*Zwangsgreifen*) used by Schuster.[58] In the patients observed by Mayer and Reisch the reflex could be voluntarily checked, and the persisting contraction of the hand over the object could be voluntarily relaxed. In all the patients there was a definitely increased tendency to grasp or to clutch for objects in view or to seize objects touched. This increased tendency is manifested also in "after-grasping," i. e., maintenance of the contracted hand after the object has been removed. Also, this "after-grasping" can be voluntarily discontinued by the patient. Schuster's term (*Zwangsgreifen*) should be reserved for grasping that is beyond voluntary control, even when the object grasped gives pain. In the present series of cases the grasping was checked in the presence of objects that would have caused pain. As the muscular contraction could be voluntarily relaxed, this phenomenon must be differentiated from "persisting contraction" or perseveration, in which a certain time must pass before relaxation is possible. If an effort is made to release the seized object the resistance is increased. Kleist [59] termed this a "circumscribed negativistic symptom."

Kennard, Viets and Fulton [60] carefully studied the case of a patient who proved to have an astrocytoma confined to the premotor area of the cortex. The close resemblance of the findings in their patient with those in chimpanzees following extirpation of the premotor area was striking. This group of symptoms—namely, forced grasping, spasticity, increase of the tendon reflexes of the digits, gradual impairment of skilled movements of the fingers and vasomotor disturbances of the affected extremity—they have designated "the syndrome of the premotor cortex."

Increased Intracranial Pressure.—Headache is recognized as one of the signs of increased intracranial pressure, and in cases of tumor of the frontal lobe it is one of the early symptoms. Headache was present in seventy-three of our series of one hundred and five cases. Vomiting, another symptom often associated with increased pressure, occurred

56. Bucy, P. C.: Brain **54**:480, 1931.

57. Mayer, C., and Reisch, O.: Deutsche Ztschr. f. Nervenh. **102**:28, 1928.

58. Schuster, P.: Psychische Störungen bei Hirntumoren: Klinische und statistische Betrachtungen, Stuttgart, Ferdinand Enke, 1902, p. 368.

59. Kleist, K.: Monatschr. f. Psychiat. u. Neurol. **65**:317, 1927.

60. Kennard, Margaret A.; Viets, H. R., and Fulton, J. F.: Brain **57**:69, 1934.

in fifty-one patients. Fifty of the patients in this series complained of failing vision, and choked disk was found in forty-eight.

Hypersomnolence.—Drowsiness, somnolence and stupor, or coma, have often been referred to in discussions of lesions of the frontal lobe, especially in the terminal stage. These signs were noted in 33 per cent of our patients—eight were drowsy, six were somnolent and twenty varied between a semistuporous and a stuporous state. Hypersomnolence was present in twenty patients with a tumor on the right side, in eleven with a tumor on the left side, and in three with a bilateral tumor. Eleven of the thirty-four patients exhibiting these signs gave no preceding history of mental symptoms.

When the somnolence is of long duration the term hypersomnolence is used, and in some cases this symptom is so pronounced as to suggest epidemic encephalitis. In 1925 two cases of tumor of the frontal lobe were reported in which somnolence was such a conspicuous feature that the authors [61] described them as cases of narcoleptic tumor of the frontal lobe.

Whether the symptoms are due to lesions of the frontal lobe or of neighboring structures is a question. In his discussion of Rowe's [62] contribution on tumors of the temporal lobe Spiller [63] said that it is impossible to give sharp limitations to any lobe of the cerebrum as regards symptomatology, because a lesion of contiguous areas may produce similar symptoms; especially is this true, he said, in relation to symptoms having their origin in the diencephalon, i. e., parts about the third ventricle. Either lobe, one must assume, frontal or temporal, extends inward as far as the third ventricle, and it is more difficult to limit it at the ventricular portion than on the surface of the cortex. Spiller, in his discussion, referred to the work of Stefan Weisz, who, in a study of six patients with a tumor about the third ventricle, mentioned hypersomnia as one of the characteristic phenomena. If this is true, hypersomnolence must be regarded as a neighborhood symptom, a symptom of involvement of the diencephalon, in any discussion of localization in the frontal lobe. In a patient recently referred to us Dr. Spiller localized the tumor as extending into the region of the periventricular gray matter of the third ventricle, and his decision was finally verified.

Stupor and somnolence have been observed frequently in patients with a tumor of all the lobes characterized by marked intracranial pres-

61. Léchelle, Alajouanine and Thévenard: Bull. et mém. Soc. méd. d. hôp. de Paris **10**:1347, 1925.

62. Rowe, S. N.: Verified Tumor of the Temporal Lobe: A Critical Review of Fifty-Two Cases, Arch. Neurol. & Psychiat. **30**:824 (Oct.) 1933.

63. Spiller, W. G., in discussion on Rowe,[62] p. 840.

sure. If the observations of Stefan Weisz are confirmed, these symptoms may be due to distention of the ventricular system, including the third ventricle. As a means of differentiation it has been suggested that a hypertonic solution be used. If the symptoms are due to the pressure of a distended third ventricle they may subside.

Anosmia.—Disturbance of smell accompanies a tumor situated so as to exert pressure on the olfactory tract. This is true especially of a tumor of the base of the frontal lobe and more particularly of a fibroblastoma of the olfactory groove. Anosmia is frequently associated with a fibroblastoma of the frontal pole or sphenoid ridge, but rarely with a parasagittal fibroblastoma. Altogether there were twenty-six instances of anosmia in our series (bilateral in sixteen and ipsilateral in ten). It was present in 32 per cent of the cases of fibroblastoma and in 20 per cent of the cases of glioma.

Ophthalmic Phenomena.—In the routine ophthalmic examinations a number of phenomena were recorded, (1) some indicative only of an increase in intracranial pressure, (2) some indicative only as to whether the tumor was in one hemisphere or the other and (3) some offering a clue as to the precise location of the tumor. Papilledema was recorded as present in forty-eight patients (46 per cent); the greater elevation was ipsilateral in six cases, contralateral in seven and equal in the two eyes in thirty-five. Bilateral primary atrophy of the optic nerve was mentioned only three times.

I was impressed with the frequency with which failing vision was referred to; frequently there were intermittent attacks of failing vision, with periods of normal vision in the interval. Fifty-three patients complained of failing vision.

In the perimetric examinations of patients who were sufficiently cooperative, concentric contraction was recorded in 50 per cent, enlargement of the blindspot in 26 per cent, homonymous hemianopia in 14 per cent, bitemporal cuts in 6 per cent and a binasal defect in 1 per cent. Three patients who were blind in one eye had a defect in the visual field of the other; one had a normal visual field in one eye and a defect in the other. One patient with a fibroblastoma arising in the sylvian fissure had an ipsilateral homonymous defect. This was attributed by Spiller [64] to pressure on the contralateral visual pathway.

Anisocoria, or inequality of the pupils, was noted in twelve cases; it was ipsilateral in seven and contralateral in five. Exophthalmos, when unilateral, is important as indicating on which side the tumor may be located; although by this sign alone one cannot distinguish between tumor of the frontal and tumor of the temporal lobe. In four

64. Spiller, W. G.: Ann. Surg. **101**:329, 1935.

of the five patients with exophthalmos in our series it was unilateral and in four ipsilateral (and in one contralateral). In one instance exophthalmos was specified as bilateral.

Too much emphasis has been laid on the so-called Gowers-Kennedy syndrome, that is, homolateral primary atrophy of the optic nerve and contralateral papilledema. Important as it may be, when present, as indicative of tumor of the frontal lobe, it is observed in a small minority of the cases in any series. In our series of seventy-eight cases it was present in only three instances. Furthermore, we have observed it in a case of tumor of the temporal lobe, and in one instance, in the experience of a colleague, the findings were reversed. Primary atrophy of the optic nerve was contralateral, and papilledema was ipsilateral; had it not been for the pneumogram the exploration would have been made on the wrong side. Two patients showed primary atrophy of the optic nerve on the side of the tumor and a normal disk on the opposite side. Two others had a normal disk on the ipsilateral side and a choked disk on the contralateral side.

SUMMARY

One hundred and five cases of tumor limited almost entirely to the frontal lobe have been analyzed.

The rate of growth of a neoplasm does not affect appreciably the percentage incidence of the symptoms and signs or the clinical picture as a whole.

A clinical syndrome has been described for fibroblastomas of the sphenoid ridge, olfactory groove and both frontal poles and parasagittal fibroblastomas, and the differential diagnosis has been discussed.

"Frontal ataxia," mental symptoms, hemiparesis and convulsions were frequent in cases of parasagittal fibroblastoma but rare in cases of fibroblastoma which took origin from the base of the skull. The olfactory and optic nerves were often affected in the cases of basilar tumor.

Vesical dysfunction was present in twenty-five cases and morbid hunger in three.

The diagnostic and physiologic significance of mental changes, "frontal ataxia," vesical dysfunction, morbid hunger, postural and reflex changes, the grasp reflex, hypersomnolence, anosmia and ophthalmic phenomena has been discussed.

MENTAL SYMPTOMS IN CASES OF TUMOR OF THE TEMPORAL LOBE

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The purpose of this investigation was to ascertain: (1) the frequency and nature of abnormal mental states in cases of tumor involving the temporal lobe; (2) the diagnostic value of such states as localizing symptoms; (3) whether the frequency and nature of the mental symptoms of a tumor involving the temporal lobe only differ from those of a tumor of the temporal lobe and its adjacent areas, and (4) whether there is any significant difference in frequency and nature between the mental symptoms of tumor of the temporal lobe and those of tumor of the frontal lobe.[1]

A survey of the more recent literature on the symptomatology of tumor of the temporal lobe discloses that some observers have reported the presence of mental symptoms in only 8 per cent of cases while others had found them in every case. This statistical disparity is encountered in the reports not only as to the frequency but also as to the nature of the mental symptoms. This may be due to the superficiality and haste with which most patients with tumor of the brain are studied psychiatrically. Routine painstaking examinations of these patients' mental reactions may reveal abnormalities which are so fine that they escape detection unless as careful a search is made for them as for somatic evidences of an intracranial expanding lesion.

In a previous communication two of us[2] commented on the difficulties of determining and evaluating mental symptoms in cases of tumor of the frontal lobe. These difficulties may be still greater in cases of tumor of the temporal lobe owing to the relatively greater frequency of aphasic manifestations in association with a lesion in this location.

From the Neurologic Service of the Mount Sinai Hospital, Dr. Israel Strauss, Attending Neurologist.

Read at the Sixty-First Annual Meeting of the American Neurological Association, Montreal, Canada, June 4, 1935.

1. To answer this question we compared the data obtained from this study with those on 64 cases of tumor of the frontal lobe previously reported by two of us.[2]

2. Strauss, I., and Keschner, M.: Mental Symptoms in Cases of Tumor of the Frontal Lobe, Arch. Neurol. & Psychiat. **33**:986 (May) 1935.

MATERIAL AND METHOD

This study was based on 110 personally observed cases, in 31 of which the diagnosis was verified by operation and in 79 by operation and necropsy. The location of the tumors and their histologic structure are shown in the table.

We analyzed our material from the point of view of changes in personality, disturbances in the sensorium, affect (including euphoria and facetiousness), memory and orientation, intellect and higher psychic functions and sphincteric control. Under disturbances of sensorium we included the various types of hallucinations as well as the peculiar abnormal mental reactions associated with the convulsive state—the so-called uncinate seizures. Transitory abnormal mental reactions following operation or intracranial injections of air were not regarded by us as symptoms of tumor and were therefore not included in the study. The data obtained during observation in the hospital were evaluated, whenever possible, in connection with corroborated information as to the patient's mental state before admission to the hospital, especially as to when the abnormal behavior began to attract the attention of others.

Location and Histologic Structure of Tumors

	Right Temporal Lobe	Left Temporal Lobe	Right Temporal Lobe and Adjacent Parts	Left Temporal Lobe and Adjacent Parts	Total Number of Cases
Number of cases	8	24	37	41	110
Glioma	8	18	30	35	91
Meningioma	..	6	2	5	13
Sarcoma	..	..	3	..	3
Tuberculoma	..	..	..	1	1
Carcinoma (metastatic)	..	..	2	..	2

RESULTS

In the entire series mental symptoms were observed in 103 patients (94 per cent); in 38 patients (35 per cent) they were early manifestations of tumor (chart 4).

A study of the findings at operation and observations at necropsy in the cases of patients with mental symptoms revealed no definite relationship between the location and nature of the tumor and the frequency and nature of the mental symptoms. We found that circulatory disturbances followed by secondary softenings in the brain tissue immediately adjacent to the tumor due to direct compression of the blood vessels by the tumor, as well as circulatory disturbances in regions remote from the tumor, probably play as important a rôle in the production of mental symptoms as the tumor itself.

Seventy-nine patients (72 per cent) with mental symptoms showed evidences of intracranial hypertension (chart 1); the latter therefore appears to be an important factor in determining the frequency of mental symptoms in patients with tumor of the temporal lobe.

DISTURBANCES OF THE SENSORIUM

Under disturbances of the sensorium we included faulty perception and attention, poor concentration and lack of cooperation, confusion, somnolence and other manifestations of impaired consciousness.

Such symptoms were observed in 87 patients (79 per cent), as shown in charts 2 *A* and 4; they were the earliest manifestations of tumor in

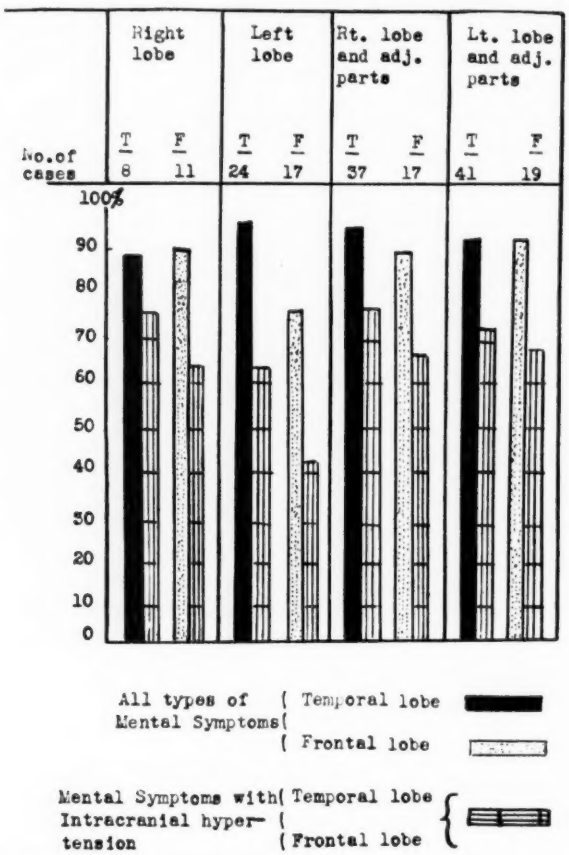

Chart 1.—Comparison of mental symptoms in relation to intracranial hypertension in 110 cases of tumor of the temporal and in 64 cases of tumor of the frontal lobe.

10 patients (12 per cent). In only 1 of these did the tumor involve only the temporal lobe; in the remaining 9 it involved either the right or the left temporal lobe and adjacent areas.

Of the 87 patients with disturbances of the sensorium, there were evidences of intracranial hypertension on admission in 61 (70 per cent); among 24 patients with disturbances of the sensorium and with the

tumor located exclusively in the temporal lobe 14 (58 per cent) had evidences of intracranial hypertension; of 63 patients with disturbances of the sensorium and the tumor in either temporal lobe and its adjacent areas, 39 (60 per cent) had evidences of intracranial hypertension. Of the 10 patients in whom disturbances of the sensorium were the earliest manifestations of tumor, 8 (80 per cent) had evidences of intracranial hypertension on admission.

There is apparently a definite relationship between disturbances in sensorium and intracranial hypertension.

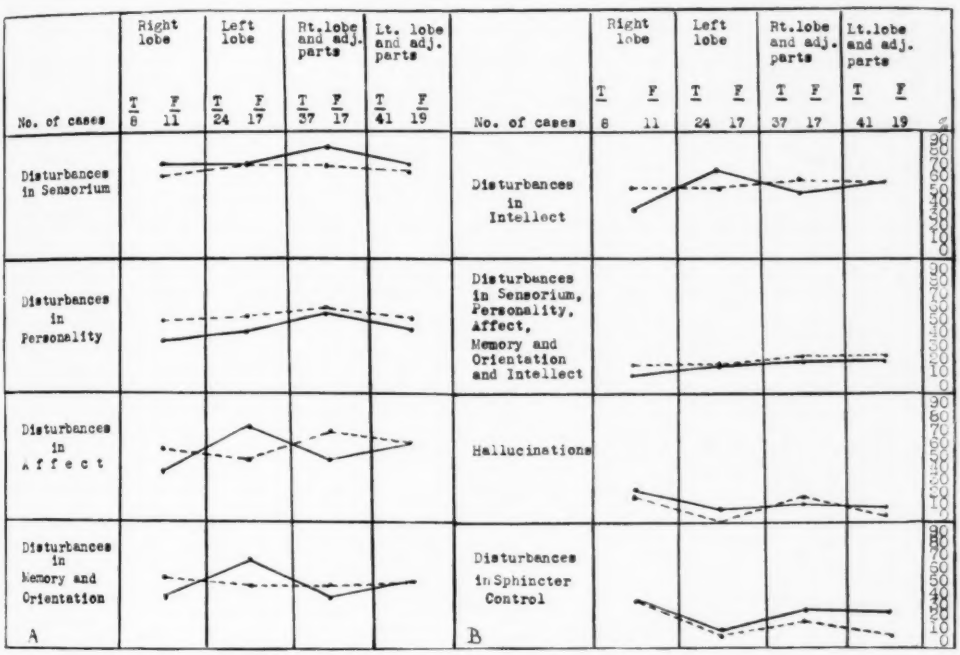

Chart 2.—Comparison of types of mental symptoms in 110 cases of tumor of the temporal and in 64 cases of tumor of the frontal lobe. The solid line shows the curve for cases of tumor of the temporal lobe; the line of dashes, the curve for cases of tumor of the frontal lobe.

Mental dulness, torpor or apathy was observed in 55 patients (63 per cent); in 27 of these the tumor was on the right side, and in 28 it was on the left side. Thirteen patients in whom the tumor involved only the temporal lobe were apathetic; in 5 of these the tumor was on the right side, and in 8 it was on the left side. Some of these patients lay in bed with half-closed eyes, yawning and persistently rubbing the nose, apparently indifferent to their surroundings; they did not speak spontaneously, but when urged to speak they did so slowly and deliberately but strikingly correctly, leaving no doubt of the intactness

of the intellect. Some authors have attributed localizing significance to this type of torpor, regarding it as indicative of tumor of the frontal lobe, and they have designated it "frontal stupor." We studied this peculiar disturbance of sensorium in patients with tumor of the frontal lobe and compared it with that in patients with tumor of the temporal lobe, but we could find no significant differences between the two. Similar somnolent states are observed in association with tumors and other pathologic processes in sites other than the frontal or temporal lobes.

HALLUCINATIONS

Hallucinations are regarded by some observers as pathognomonic symptoms of involvement of the temporal lobe. They are defined by White [3] as "perceptions without sensory foundations." They must be distinguished from illusions, in which a stimulus coming from the outside world or arising spontaneously anywhere in the peripheral sensory apparatus undergoes distortion while on its way to the sensorium so that it reaches consciousness in a falsified form.

Hallucinations may be visual, auditory, olfactory, gustatory, haptic, visceral and kinesthetic. Those most commonly observed in patients with tumor of the temporal lobe are olfactory, visual, auditory or gustatory or a combination of these varieties. Hallucinations may be the first manifestations of tumor, or they may not appear till the patient has become confused or delirious as a result of intracranial hypertension. In some patients hallucinations may disappear after removal of the tumor or even after a decompression.

In our series hallucinations occurred in 15 patients (14 per cent), as shown in charts 2 *B* and 4; in 2 the tumor occupied the right temporal lobe and in 3 the left; in 6, the right temporal lobe and adjacent structures, and in 4, the left temporal lobe and adjacent structures. Three patients had visual hallucinations, 1 auditory, 4 olfactory, 2 olfactory and visual, 1 visual and auditory, 1 olfactory and auditory and 1 olfactory, auditory and visual. Two patients reacted to hallucinations the nature of which could not be determined.

Hallucinations to be of diagnostic value in cases of tumor of the brain must not be associated with a psychosis. Furthermore, it is important to determine whether they are crude or complex. Crude, or so-called elementary, hallucinations may be due to intracranial hypertension or to structural or functional alterations in the lowest neural pathways mediating smell, vision, hearing, taste, touch and movement, whereas complex hallucinations are due to disturbances in the higher centers for these functions, resulting in inadequate reality orientation.

3. White, William A.: Outlines of Psychiatry, ed. 3, Washington, D. C., Nervous and Mental Disease Publishing Company, 1911, p. 43.

Olfactory and Gustatory Hallucinations.—In cases of tumor of the temporal lobe involving the uncinate gyrus, olfactory and gustatory hallucinations are not infrequently associated with each other. Patients with such hallucinations complain of a disagreeable odor or taste for which there is no cause in the environment. The disagreeable sensations are often accompanied by sniffing, smacking, chewing and tasting movements.

The following two cases in our series are good illustrations of olfactory hallucinations:

Case 1.—A woman, aged 39, began to suffer from headache five weeks before admission; at times the headache was associated with a "smell of paint"; whenever this occurred the headache became unusually severe; at other times the headache would "recall the odor of paint." On admission the patient complained of smelling a "disagreeable odor of burning rubber." In addition to the neurologic evidences of an expanding intracranial lesion in the right cerebral hemisphere, there were mental retardation and drowsiness. At operation, two days after admission, a spongioblastoma was removed from the depths of the posterior part of the right temporal lobe; ten weeks later there appeared evidences of recurrence of the tumor, and six weeks thereafter, at a second operation, the tumor was found to have recurred in the right temporal lobe and invaded the parietal lobe on the same side.

Case 2.—A man, aged 42, stated that two weeks before admission he had "smelled bad odors." Repeated nasal examinations gave negative results. He soon began to vomit, and there developed headaches, dizziness, transient disorientation and increasing general weakness. On admission he showed evidences of an expanding lesion in the left cerebral hemisphere and marked mental deterioration.

Necropsy disclosed a large spongioblastoma involving the left parietal lobe, the posterior part of the left temporal lobe and the adjacent portion of the left occipital lobe.

Gustatory and olfactory hallucinations may be associated with peculiar paroxysmal alterations of consciousness, the so-called "dreamy states." These transient psychic episodes usually appear in the form of attacks of petit mal which are preceded or followed by hallucinations of smell or taste or by an epigastric or other visceral sensation—"uncinate seizures." In some cases there may be no loss of consciousness but a sudden feeling of unreality in which the patient appears "vacant with a lost look and mind." Some of the patients may also have generalized convulsions preceded by an aura consisting of a "dreamy state." According to Jackson [4] the dreamy state is not an aura but a striking symptom of a certain variety of epileptic attack—a "very elaborate or voluminous mental state." Some patients complain of a "feeling of having been in exactly the same situation before"—the déjà vu state. This is relatively rare, and we did not observe it in any

4. Jackson, John Hughlings: On a Particular Variety of Epilepsy, Brain **11**:179, 1888-1889.

of our cases. Dreamy states are not always accompanied or preceded by uncinate seizures, and the latter are not constantly followed by dreamy states.

A review of more recent literature on olfactory and gustatory hallucinations and "dreamy states" in cases of tumor of the temporal lobe discloses some striking variations in their frequency.

Kennedy [5] in analyzing a series of 9 cases of tumors of the temporal lobe from the National Hospital, Queen Square, London, England, found 7 cases in which "dreamy states" occurred. Knapp [6] regarded olfactory and gustatory hallucinations as characteristic of involvement of the temporal lobe but stated that they are not particularly frequent. Horrax [7] found among 72 cases of tumor of the temporal lobe 17 in which visual hallucinations were present; in 13 of these the hallucinations were associated with "uncinate seizures." Rowe [8] spoke of hallucinations of taste and smell, i. e., uncinate attacks, as "the most valuable symptoms of this type from a diagnostic standpoint"; they were found, however, in only 6 of his 52 cases. Kolodny [9] observed uncinate seizures in 7 of 38 cases of tumor of the temporal lobe; in 3 of the 7 cases the seizures preceded the dreamy state. Dreamy states not preceded by uncinate seizures occurred in 4 cases, and in 1 there was a definite auditory aura followed by a local motor fit. In 1 case the uncinate seizures were always ushered in by attacks of parasthesia in the left foot. All observers agree that dreamy states are complex psychic phenomena which only patients with more than average intelligence are capable of describing.

Among our patients only 2 exhibited dreamy states; in 1 of these they were associated with olfactory hallucinations and in the other with complex visual and auditory hallucinations; in both patients the tumor involved the frontal and temporal lobes. On the other hand, there were 7 patients who had olfactory hallucinations without dreamy states. It is noteworthy that none of our patients in whom the tumor occupied only the temporal lobe had olfactory hallucinations associated with the dreamy state. In only 2 of the patients who had olfactory hallucinations did the tumor involve the frontotemporal region, whereas in the other 6

5. Kennedy, Foster: Symptomatology of Temporosphenoidal Tumors, Arch. Int. Med. **8**:317 (Sept.) 1911.

6. Knapp, A.: Die Tumoren des Schläfenlappens, Ztschr. f. d. ges. Neurol. u. Psychiat. **42**:226 (April) 1918.

7. Horrax, Gilbert: Visual Hallucinations as a Cerebral Localizing Phenomenon, Arch. Neurol. & Psychiat. **10**:532 (Nov.) 1923.

8. Rowe, Stuart N.: Verified Tumor of the Temporal Lobe, Arch. Neurol. & Psychiat. **30**:833 (Oct.) 1933.

9. Kolodny, Anatole: The Symptomatology of Tumors of the Temporal Lobe, Brain **51**:385 (Oct.) 1928.

the tumor involved either the temporal lobe alone or the temporal lobe and other adjacent areas except the frontal.

In the following cases various types of uncinate phenomena were a prominent feature in the clinical picture:

CASE 3.—A man, aged 50, three months before admission experienced a sudden attack of temporal anomia which was soon followed by attacks of petit mal. Six weeks later he began to have severe headache, which was most marked in the left frontoparietal region. On several occasions he had episodes during which he smelled "peculiar odors," usually of a "foul nature." On admission he had, in addition to the neurologic signs indicative of an expanding lesion in the left cerebral hemisphere, motor and sensory aphasia with severe mental symptoms referable to almost every psychic sphere. The pressure of the cerebrospinal fluid was 260 mm. of water.

Necropsy revealed a spongioblastoma in the left cerebral hemisphere; the growth had destroyed the posterior part of the frontal lobe, the entire temporal lobe, the island of Reil and the adjacent parts of the parietal and occipital lobes.

This patient had uncinate phenomena and attacks of petit mal but no dreamy states, although the tumor had destroyed the entire temporal lobe.

CASE 4.—A man, aged 45, with a history of a tumor at the base of the brain for nine years, thirteen months before admission had episodes during which he smelled "horrible odors" which he could not identify. During some of the episodes he also became "dizzy" and "dreamy"; occasionally he was "unable to utter the words that he wanted to say and stood speechless till the attack was over." He had no loss of consciousness. The attack lasted from two to three minutes and occurred twice a day for a period of seven months, after which there developed generalized convulsions; with the appearance of the convulsions the uncinate phenomena ceased. The only other mental abnormality was some difficulty in recalling most recent events. There was no aphasia. The pressure of the cerebrospinal fluid was 190 mm. of water.

Necropsy disclosed a meningioma which sprang from the region of the clinoid processes, compressing the posterior portion of the left frontal lobe and the inferior surface of the left temporal lobe.

This patient had olfactory hallucinations associated with "a dreamy state" and attacks of petit mal—typical uncinate seizures such as are observed in association with a lesion at the tip of the temporal lobe. The complete cessation of the uncinate seizures after the onset of generalized convulsions is noteworthy.

CASE 5.—A man, aged 56, five weeks before admission suddenly experienced severe frontal and occipital headache; three weeks later he began to have frequent attacks of giddiness and a sensation of "a peculiar overpowering sweetish odor and of seeing clouds." These attacks occurred while he was walking, so that he had to "steady himself not to fall." On admission, though fatigued, he was garrulous, euphoric and facetious and showed evidences of an expanding lesion in the right cerebral hemisphere, marked bilateral papilledema and a suggestion of left homonymous hemianopia.

Necropsy disclosed a large spongioblastoma involving almost the entire posterior half of the right temporal and the entire right occipital lobe.

This patient had crude visual and olfactory hallucinations associated with mild attacks of petit mal (uncinate seizures). The presence of evidences of intracranial hypertension and of the other mental symptoms as well as the crude

nature of the visual hallucinations made it difficult to attribute localizing value to the latter, although the uncinate phenomena pointed more definitely to involvement of the temporal lobe.

CASE 6.—A man, aged 29, two and a half years before admission experienced headaches and inability to concentrate. One year later memory became defective and there appeared a gradual change in character. During this period he had definite uncinate seizures and on several occasions reacted to hallucinations, the nature of which could not be determined. On one of these occasions he suddenly became "unable to say what he wanted," and there developed a manic episode, for which he was admitted to a hospital for patients with mental disease. This episode disappeared in two or three days; then the patient again reacted to hallucinations. On admission to the Mount Sinai Hospital he showed evidences of an expanding lesion in the left cerebral hemisphere. After an exploratory operation, with an unsuccessful attempt to remove the tumor, the patient died.

Necropsy dislosed a neuroblastoma of the left temporal lobe.

This patient was definitely psychotic; the hallucinatory reactions and uncinate seizures could not be evaluated.

CASE 7.—A man, aged 25, a journalist, about a year before admission, while at work, suddenly looked to the extreme right, and simultaneously there developed cardiac palpitation and sweating and he saw "various lights and shadows"; at the same time he heard "female contralto voices chanting to a magniloquent declamation." He also felt weak and tired and "tried with all his might to remain conscious and not to faint." This episode lasted from one to two minutes. Similar episodes recurred daily throughout the year. He soon found that he could bring on the episodes at will and prolong them for as long as three minutes. He believed that "it was an act of forbidden fruit, so that it was incumbent on him to stop these attacks by will power." With the aid of a tonic (?) given to him by a local physician he was "successful in stopping the attacks for from four to five months, but they have since then recurred." "It is tempting for him to indulge in his flights, so he does not resist." The patient spoke earnestly of being interested in music; he was especially fond of full contralto voices. He was "envious of men whose oratory could hold audiences spellbound."

Examination revealed stammering speech, euphoria and some hyposmia, with evidences of an expanding lesion in the right cerebral hemisphere; the pressure of the cerebrospinal fluid was 550 mm. of water. Studies of the visual fields revealed left homonymous superior quadrantanopia. At operation a glioma was found in the anterior part of the right temporal and the most posterior portion of the frontal lobe.

This patient apparently had crude visual hallucinations on looking to the extreme right and auditory hallucinations of the type said to be pathognomonic of a tumor of the frontal and temporal lobes. The visual hallucinations were associated with attacks of palpitation and sweating; the latter may possibly have been vasomotor epileptiform equivalents. The auditory hallucinations were accompanied by definite petit mal seizures. The patient's subsequent psychic elaboration of the auditory hallucinations is, in our opinion, an expression of his personality and more or less artistic temperament. He also enjoyed "indulging in his flights." These were apparently dreamy states, some of which he could provoke at will by recalling what he regarded as pleasant "memory pictures" of full contralto voices. The dreamy state and auditory hallucinations which he could provoke at will, together with the fact that his stammering made him "envious of men who could by their speaking hold audiences spellbound," could

be interpreted psycho-analytically as a wish fulfilment. The case illustrates how readily one could fall into error by regarding this entire mental symptom complex as psychogenic in origin, especially as the auditory hallucinations and dreamy states preceded by almost a year the appearance of symptoms and signs of an expanding intracranial lesion. The case further illustrates the fact that when such phenomena occur in a patient showing signs suggestive of a tumor of the brain but no other evidences of mental disease they may be regarded as localizing symptoms indicative of involvement of the frontal or temporal tobe.

Visual Hallucinations.—Visual hallucinations may be crude or complex. Crude or elementary visual hallucinations may be in the nature of flashes of light, colored lights, scintillating scotomas, specks or spots; these hallucinations are also designated as "unformed visual hallucinations." Patients with complex or formed visual hallucinations describe them as stationary or rapidly moving lights or as figures or objects of various kinds and sizes. Objects and persons seen in hallucinations often appear distorted and grotesque.

Cushing expressed the belief that visual hallucinations in cases of tumor of the temporal lobe bear some relation to involvement of the optic radiations, because in his cases the hallucinations were always referred to the defective halves of the visual field. According to him, these hallucinations may be the precursors of the defect in the visual field and as such assume localizing value. Crude visual hallucinations, on the other hand, are believed to be more frequent in cases of tumor of the occipital lobe than in cases of neoplasm occurring in other parts of the brain. Kennedy suggested in reference to the origin of visual hallucinations arising in cases of tumor of the temporosphenoid lobe that this area of the brain is "the storehouse for infantile memories which in later life are relegated to other areas of the brain. Stimulation of this area recalls these early infantile memories to consciousness, giving rise to visual hallucinations."

Horrax,[7] in studying 72 cases of tumor of the temporal lobe in Cushing's clinic, found more or less complex visual hallucinations in 5 cases. Defects in the visual fields were present in only 5 of the 12 cases at the first appearance of hallucinations.

Among our 7 cases in which visual hallucinations were present it was difficult to determine in 1 whether the patient was actually suffering from hallucinations or from illusions; in 1 case the nature of the visual hallucinations was not recorded. Among the remaining 5 cases, unformed visual hallucinations were present in 3; in 1 of the latter the tumor occupied the temporal lobe; in 1 it was located in the temporofrontal lobe, and in the third it occurred in the temporo-occipital lobe. In the 2 cases in which formed visual hallucinations were present the tumor occupied in 1 the temporoparietal and in the other the temporo-occipital lobe. It is noteworthy that only 1 of the patients, a man, aged

52 years, with a spongioblastoma deep in the right temporoparietal lobe, had formed visual hallucinations in the hemianopic defect of the field. On one occasion this patient also had olfactory hallucinations, but no dreamy state. All the patients with visual hallucinations had evidences of intracranial hypertension.

Auditory Hallucinations.—Sometimes a patient with a tumor of the temporal lobe complains of auditory hallucinations, which may be crude or complex. The former consist of hearing ringing, buzzing, hissing, blowing, whistling, crackling and loud roaring sounds, which may be disagreeable and annoying; they are most likely due to intracranial hypertension. Complex auditory hallucinations, on the other hand, consist almost invariably of hearing voices, singing or musical sounds.

Courville,[10] among 99 cases of verified tumor of the temporal lobe in the Peter Bent Brigham Hospital, found only 4 in which definite auditory hallucinations were present, and among 98 cases of tumor of the frontal lobe there were 6 in which the same type of hallucinations occurred. He found, moreover, that in the cases of tumor of the frontal lobe the auditory hallucinations were associated with other hallucinations, optic, olfactory and gustatory, and other marked mental disturbances with pronounced symptoms of intracranial hypertension, whereas the auditory hallucinations in the cases of tumor of the temporal lobe were unassociated with mental symptoms other than visual hallucinations known to originate in the temporal lobe. Courville concluded that the auditory hallucinations in cases of tumor of the temporal lobe may be considered as focal symptoms, while those occurring in cases of tumor of the frontal lobe may be due to distance phenomena of intracranial hypertension or a "part of the psychosis incident to the organic lesion or both."

In our 4 patients with auditory hallucinations the hallucinations were complex in only 2. One of these, a man, aged 33, with a large spongioblastoma involving the left temporal lobe, complained of "hearing Irish songs"; he was surprised when he was told that there was no music about him. Aural examination gave negative results, and the pressure of the cerebrospinal fluid was 540 mm. of water.

This patient had definite complex auditory hallucinations. Aside from some drowsiness and slight confusion, he showed no psychic disturbances. The hallucination of "hearing musical sounds" was most likely due to involvement of the auditory center in the temporal lobe. The patient was of Irish extraction, and this may be of some significance in connection with the fact that he "heard Irish songs." The tumor in the temporal lobe may have acted, in the terms used by Kennedy,

10. Courville, Cyril B.: Auditory Hallucinations, J. Nerv. & Ment. Dis. **67:** 265 (March) 1928.

"as a stimulus which recalled to consciousness early auditory memories that had been stored up in this area."

In another patient the complex auditory hallucinations were associated with crude visual hallucinations and a dreamy state.

In the following cases the auditory hallucinations were crude:

CASE 8.—A woman, aged 53, with a glioma deep in the right temporal lobe heard "trains running" and smelled "very irritating odors." These symptoms appeared late in the disease and were associated with drowsiness, mental dulness, impaired memory for recent and remote events and urinary and fecal incontinence. Strangely, this patient never showed objective evidences of intracranial hypertension.

The crude auditory and olfactory hallucinations, owing to their late appearance in the course of the disease and their association with other mental disturbances, were of no localizing value.

CASE 9.—A man, aged 53, with a glioma the size of a hen's egg in the superior and posterior parts of the left temporal lobe complained of "buzzing in both ears" and of "seeing objects spinning around." Aural examination gave negative results. The crude auditory hallucinations were most likely due to the intracranial hypertension.

CASE 10.—A man, aged 23, with evidences of an expanding lesion in the right cerebral hemisphere complained of seeing "halos of light more through the right eye" and of having had on three occasions attacks during which he "smelled peculiar disagreeable odors" and heard buzzing in the right ear. He had a left upper quadrantic homonymous defect in the fields, and the pressure of the cerebrospinal fluid was 380 mm. of water. Aural examination gave negative results. Operation revealed a large spongioblastoma involving the entire right temporal lobe.

This patient had visual, olfactory and auditory hallucinations. The visual hallucinations were unformed, and the auditory hallucinations were crude; they were most likely due to intracranial hypertension. The olfactory hallucinations were disagreeable, and although unassociated with the dreamy state or with any other epileptiform equivalent, they were regarded as evidence of involvement of the temporal lobe.

Comment.—Four of the 5 patients with auditory hallucinations had objective evidences of intracranial hypertension.

From a review of the literature and from our material it appears that: 1. Hallucinations of any one type by themselves are of little localizing value; in patients with a psychosis and in those with intracranial hypertension they are of no localizing value. 2. Formed visual hallucinations have some localizing value; their occurrence in a homonymous defect in the visual fields is confirmatory evidence that the tumor is in the temporal lobe on the side opposite that of the defect in the fields; in some instances formed visual hallucinations may be the precursors of a defect in the fields. 3. Complex auditory hallucinations consisting of hearing singing or musical sounds and appearing before the onset of symptoms of intracranial hypertension suggest involvement of either the frontal or the temporal lobe; their association

with formed visual hallucinations or with uncinate phenomena and dreamy states is more in favor of involvement of the temporal lobe; the triad of complex hallucinations, uncinate phenomena and dreamy states and amnesic aphasia is diagnostic of a lesion in the temporal lobe on the dominant side. 4. Olfactory and gustatory hallucinations are of localizing value only when they are associated with the dreamy state; in such cases they point to involvement of the uncinate gyrus.

CHANGES IN PERSONALITY

In conformity with our definition of "changes in personality" in a previous communication,[2] we considered that a patient was suffering from such changes whenever he showed a relatively persistent disturbance in psychosomatic integration sufficiently marked to impress those with whom he came in contact. With this definition in mind, we found 58 patients (53 per cent) showing changes in personality (charts 2 and 4); these changes were the earliest manifestations of tumor exhibited by 25 patients (23 per cent).

In 4 of these patients the changes in personality led early in the disease to such bizarre behavior that they were thought to be psychotic. In 1 the manifestations began with a manic episode for which he was taken to a hospital for psychopathic patients, where he remained three days, until the mental condition cleared up; after his discharge from that hospital there gradually developed aphasia and evidences of an expanding intracranial lesion, which proved at necropsy to be a neuroblastoma of the left temporal lobe. One patient with a spongioblastoma in the left temporal lobe and right thalamus was thought to have dementia paralytica with Korsakoff features before there developed evidences of tumor of the brain. A patient with a meningioma in the middle fossa compressing the left temporal lobe was thought for a long while to have dementia praecox. The fourth patient in this group, a man aged 35, exhibited as an initial symptom a change in personality manifested by hypomanic behavior, delusions of grandeur and suspiciousness; neurologic examination gave negative results and the disorder was diagnosed as an "unclassified psychosis"; the patient remained in this condition for two months, and then there developed generalized convulsions; encephalography revealed evidences of an expanding intracranial lesion, which proved at necropsy to be a spongioblastoma in the left temporal lobe.

In our series of cases of tumor of the frontal lobe changes in personality were the earliest symptoms of tumor in 23 per cent of the cases. It appears that changes in personality as an early manifestation of tumor of the brain occur as frequently in cases of tumor of the temporal lobe as in those of tumor of the frontal lobe. They are therefore of no localizing value.

DISTURBANCES IN AFFECT

Symptoms referable to disturbances in affect were found in 63 patients (57 per cent), as shown in chart 4. The most frequent disturbance in affect was irritability, which occurred in 28 patients (26 per cent). Twenty-one patients (20 per cent) had various states of depression, and 6 (5 per cent) were hypomanic. In 38 patients (35 per cent) disturbances in affect were associated with various forms of aphasia (chart 3).

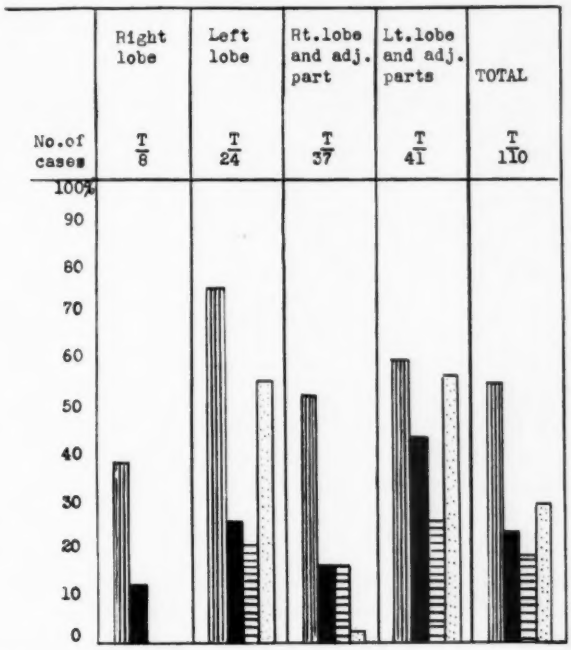

Chart 3.—Disturbance in affect, especially irritability and depression, in relation to aphasia in 110 cases of tumor of the temporal lobe. The solid areas represent irritability; the areas with vertical lines, depression; the areas with horizontal lines, disturbances in affect, and the stippled areas, disturbances in affect with aphasia.

Disturbances in affect were the earliest symptoms of tumor in 12 patients (11 per cent); 7 of these were unusually irritable; 4 were depressed, and 1 was euphoric. In this group 7 patients had a tumor exclusively of the left temporal lobe; in the remaining 5 the neoplasm involved the left temporal lobe and adjacent structures.

In only 1 patient were changes in affect the only mental symptom observed; that patient's tumor involved the left frontotemporoparietooccipital area.

It is noteworthy that changes in affect, especially irritability and depression, occurred much more frequently in patients with a tumor on the left side than in those in whom the growth was on the right side, the incidence being 20 per cent higher in the former than in the latter (chart 3). We believe that this was due to the associated aphasia in the patients with a tumor on the left side, as a result of which the patients were greatly embarrassed and were either irritable or depressed because they found it difficult or impossible to understand, or to be understood, and to speak.

Next to irritability, the most frequent change in affect was euphoria or facetiousness or both; these symptoms were exhibited by 26 patients (24 per cent). Euphoria was present in 23 patients (21 per cent), facetiousness in 12 (11 per cent) and euphoria associated with facetiousness in 9 (9 per cent). There was no significant relationship between the incidence of these symptoms and the location of the tumor.

In our series of tumors of the frontal lobe,[2] excluding those involving both hemispheres, euphoria was found in 27 per cent of the cases, facetiousness in 18 per cent, and euphoria associated with facetiousness in 9 per cent. The difference in the incidence of these symptoms in cases of tumor of the frontal lobe as compared with that in cases of tumor of the temporal lobe is so slight that it may be disregarded. Obviously, euphoria and facetiousness are pathognomonic neither for tumors of the temporal nor for those of the frontal lobe (chart 4).

It is also of interest to note that 17 patients (16 per cent) with euphoria and facetiousness showed disturbances in intellect; most of these patients showed poor judgment and had no insight into their condition.

Changes in affect were associated with intracranial hypertension in 46 patients (42 per cent), in 28 (26 per cent) of whom the tumor was on the left side of the brain and in 18 (16 per cent) of whom it was on the right side. In 43 patients with tumor on the left side and changes in affect, the latter were associated with intracranial hypertension in 28 (65 per cent), whereas of 20 patients with the tumor on the right side and changes in affect, intracranial hypertension was present in 18 (90 per cent); in other words, the incidence of disturbances in affect associated with intracranial hypertension was 25 per cent higher in patients with the tumor on the right side than in those with the tumor on the left side. We are unable to explain this difference unless one assumes that in the absence of aphasic manifestations patients with a tumor on the right side are not suspected of having a tumor until evidences of intracranial hypertension appear.

Our cases, then, seem to show that disturbances in affect play an important rôle in the mental symptomatology of tumors involving the temporal lobe. The incidence of these disturbances is almost as high

in cases of tumor of the temporal lobe as in those of tumor of the frontal lobe. Irritability seems to be the most frequent disturbance in affect associated with tumor of the temporal lobe; this is most likely due to the frequent occurrence of aphasia in such cases. Euphoria and facetiousness occur almost as frequently in cases of tumor of the temporal lobe as in those of tumor of the frontal lobe. Intracranial hypertension and aphasia are important determining factors in disturbances in affect in cases of tumor of the temporal lobe.

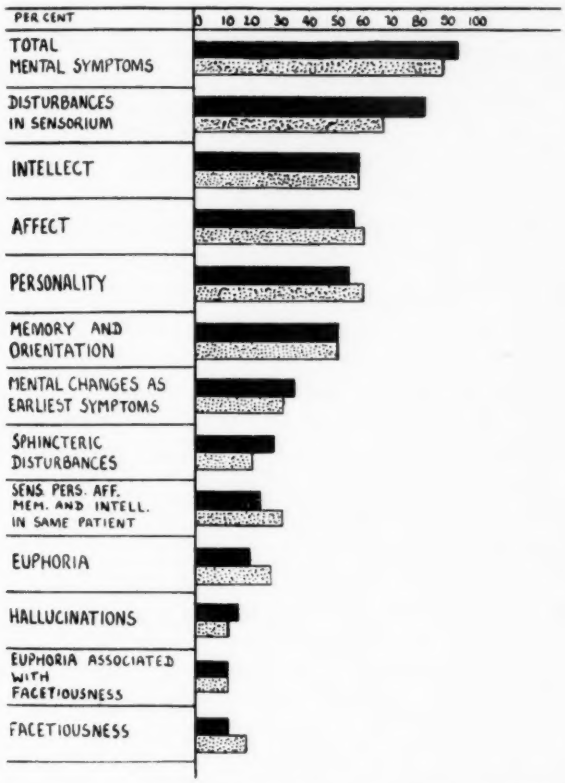

Chart 4.—Comparison of incidence of mental symptoms in 110 cases of tumor of the temporal and in 64 cases of tumor of the frontal lobe. The solid areas represent the incidence for cases of tumor of the temporal lobe; the stippled areas, the incidence for cases of tumor of the frontal lobe.

DISTURBANCES IN MEMORY AND ORIENTATION

In 55 cases (50 per cent) there occurred disturbances in memory and orientation (charts 2*A* and 4). They were the earliest symptoms of tumor in 9 patients (8 per cent); they were associated with disturbances in sensorium in 47 patients (43 per cent), with disturbances in intel-

lectual and higher psychic functions in 44 (40 per cent) and with aphasia in 29 (27 per cent); in most patients with disturbances in memory and orientation and aphasia the latter was sensory.

Disturbances in memory and orientation were associated with intracranial hypertension in 40 patients (37 per cent).

Memory consists of the power of retention or fixation, recollection and recognition. A disturbance in any of these functions may be followed by a disturbance in memory.

The power of retaining knowledge or the storing up of memories which are mainly visual and auditory impressions necessitates proper apperception, concentration, attention and mood as well as the functional integrity of the temporal lobe, which contains the highest centers (first and second temporal convolutions) for auditory impressions and the pathways which convey visual impressions to the cortical visual centers. In patients with disturbances in sensorium (attention and concentration), sensory impressions either do not enter consciousness or, if they do enter it, are distorted; the former results in failure of memory and the latter in faulty fixation of memory images. Abnormal emotional states may have a similar effect. Memory by fixation being therefore dependent largely on proper attention, this type of disturbance of memory is common in patients with tumor of the brain, because spontaneous attention is generally more affected than "provoked" attention. Periodic disturbances in consciousness due to variations in intracranial tension may produce in some of these patients veritable "eclipses of memory."

Recollection or evocation occurs through association of experiences, concepts and images. This faculty is enhanced by frequent repetitions of the latter. The stored-up memories are revived by association and brought into consciousness. Faulty association results in poor recollection, which may lead to falsification and distortion. Slight distortion or minimal falsification may occur normally, but under certain abnormal conditions the distortion of memory images may be so great that they become utterly unrecognizable. This process is designated as memory falsification, and it may be partial or complete. When memory falsification is associated with a lively imagination and an abnormal emotional state there may result confabulation of the type observed in the Korsakoff syndrome.

Recognition, according to Forel,[11] is "the ability to appreciate that a revived memory image is the same as its original." Thus there may occur a disturbance in memory during which a memory picture appears without the patient's knowledge of its source of origin and without his ability to identify it with its original memory picture. Forel pointed

11. Forel, August: Hygiene der Nerven und des Geistes, ed. 2, Stuttgart, E. H. Moritz, 1905, p. 26.

out that "psychologically this would not be a memory image because the patient does not remember it, nevertheless it can be proven indirectly that it is a memory process; an author may write a sentence or compose a melody which he thinks is original with him although as a matter of fact he heard the sentence or the melody elsewhere, but fails to recognize it."

In testing memory it is essential to eliminate as far as possible complex intellectual processes and to determine whether retention, recollection and recognition are intact. The usual psychologic tests for memory, which dissociate memory from reasoning, will ordinarily reveal that in patients with a tumor of the brain the disturbances in memory are mostly in the power of retention (fixation) and recollection and least in the power of recognition. This is in marked contrast to disturbances in memory in patients suffering from dementia, especially from dementia paralytica, in whom retention, recollection and recognition are usually affected.

It must be borne in mind that in patients with a tumor of the brain and disturbances in memory the difficulty in recollection is more apparent than real. This is especially the case in patients with a tumor involving the temporal lobe on the dominant side who are also suffering from amnesic aphasia—temporal anomia. In testing memory in these patients it is necessary to ascertain whether they have lost the power of retaining "knowledge in the mind" or the power to recall such "knowledge." It may thus be found that such patients are unable to recall words spontaneously although they have not lost their "memories" of these words, as shown by their ability to repeat them on hearing or seeing them. These patients can nearly always recognize the correct word and select it accurately from a number of words suggested to them. Most patients with amnesic aphasia are conscious of their defect of speech and are embarrassed by their inability to recall the correct words; they resort to circumlocution and to a description of the characteristics of the object or of the person connoted by the word or name which they are unable to evoke spontaneously. Writing may be similarly affected. In such patients the disturbance in speech involves mostly proper names and substantives. "In amnesic aphasia," according to Kennedy [5] "there is no true loss of memory for words; memory is to a great extent intact, but what is defective is the ability to evoke the proper word at the desired moment; the words exist but remain in the subconscious; the memory for words is not impaired but submerged and can be recalled by a great volitional effort, or it can be recognized by the aid of a visual or auditory stimulus." This selective inability to recall proper names and substantives is, according to Kussmaul, due to the fact that abstract ideas are more connected with words than are concrete ideas; the latter evoke first of all sensory, visual, auditory and other images; it is only secondarily that the verbal image comes to aid. A good illustration of

this may also be observed normally when the visual image of a person can be much more easily evoked than his name.

When amnesic aphasia is associated with motor aphasia memory can be investigated only by the so-called nonlanguage performances; the information obtained from these tests is not always reliable and may be difficult to record and to analyze. When the aphasia is also associated with such mental changes as confusion, incoherence, irrationality and general deterioration of the higher psychic functions, no conclusions can be drawn from any examination for disturbances of memory.

We pointed out in a previous communication [2] the unsoundness of Ribot's law, according to which in patients with organic disease of the brain memory for recent events is more affected than memory for remote events; in these cases memory for recent events is mostly affected because there is nearly always a coexisting disturbance in sensorium and affect, as a result of which recent events and sensory stimuli either do not enter consciousness or, if they do enter it, do not make a psychic impression of sufficient intensity to be recalled; i. e., amnesia occurs by faulty fixation.

Memory and orientation are so closely related psychologically that it may be impossible to distinguish them clinically. Orientation is a complex psychic function which enables one to appreciate one's relation to the environment and to oneself regarding time, space and person. Disturbances in sensorium, affect, memory, reasoning and judgment may give rise to disorientation for time, place or person or for all of these; i. e., the disorientation may be partial or complete.

Memory in its final analysis consists largely of impressions of concrete and abstract experiences. When, owing to disease of the brain, impressions do not enter consciousness in their true form or with sufficient intensity, or when they are not properly understood, adequately associated and correctly reasoned about, they obviously leave no memories or at best only imperfect memories. Hence it seems that memory is a function of the entire brain.

In this connection we wish to point out that in our study of cases of tumor of the frontal lobe we found disturbances in memory and orientation in 50 per cent of cases, and the frequency of these disturbances in our series of cases of tumor of the temporal lobe was also 50 per cent. There is apparently no difference in the incidence of disturbances in memory and orientation in cases of tumor in either of these localizations (chart 4).

DISTURBANCES IN INTELLECT AND HIGHER PSYCHIC FUNCTIONS

Disturbances in intellect and the higher psychic functions were found in 62 patients (56 per cent); they were early symptoms of tumor in 21 (20 per cent). They were associated with disturbances in sensorium in 56 patients (54 per cent), with changes in affect in 48 (44 per cent),

with disturbances in memory and orientation in 44 (40 per cent), with aphasia in 34 (31 per cent) and with intracranial hypertension in 49 (45 per cent). Fifteen patients (14 per cent) had disturbances in intellect associated with disturbances in sensorium, affect, memory and aphasia, and 25 patients (23 per cent) had disturbances in intellect, sensorium, affect and memory (charts 2 *B* and 4).

Most patients with disturbances in attention, concentration, association, memory and affect had difficulty in comprehension resulting in confusion and inability to reason correctly. Some were actively hallucinating, mildly delusional and at times delirious and showed poor judgment and lack of insight. Others showed intellectual enfeeblement manifested by marked disturbances in memory and orientation, mental retardation and a peculiar indifference occasionally interrupted by foolish laughter and generally childish behavior, and still others had no difficulty in making integrations of simple concrete concepts but failed partly or completely with more complex concepts.

The loss of comprehension of language seemed to have an unfavorable effect on thinking, so that the patients with severe aphasia, apraxia and agnosia nearly always showed some degree of intellectual impairment.

Logical thinking and correct reasoning depend on the ability to synthesize concepts and impressions. Adequate perception, a good memory and proper association are essential for correct elaboration and integration of concepts and impressions. A pathologic process, regardless of its nature and location in the brain, affecting the anatomic or physiologic substratums for perception, memory and association must necessarily interfere with proper synthesis. The temporal lobe, containing the cortical centers for speech, hearing, taste and smell, the conducting pathways for vision and a rich association network, must therefore play a significant rôle in proper integration and synthesis. Obviously a tumor in the temporal lobe involving any or all of these centers and pathways will interfere with their normal functioning and give rise to faulty synthesis with consequent disturbances in intellect and the higher psychic functions.

It is noteworthy that disturbances in intellect and higher psychic functions occurred as frequently in our patients with tumor of the temporal lobe as in those with tumor in the frontal lobe (chart 4). Nor was there any difference in the nature of these symptoms produced by a tumor in these two localizations.

SPHINCTERIC DISTURBANCES

Sphincteric disturbances, not including those occurring during the convulsive state, were present in 28 patients (25 per cent—chart 2 *B*); urinary incontinence was present in 20, and urinary and fecal inconti-

nence in 8. One patient with a glioma involving the right temporal lobe and adjacent structures had urinary retention. In 16 patients with sphincteric disturbances there were also evidences of intracranial hypertension.

There seemed to be no definite relationship between these symptoms and the location, nature or size of the tumor. In all our cases in which sphincteric disturbances were present they appeared late in the disease, when the patients were drowsy, confused or so deteriorated that they were merely "vegetating." Disturbances in sphincteric control are most likely an expression of the abnormal psychic state of these patients, and as such they assume the rôle of a general symptom of tumor of the brain.

There was no significant difference between the frequency of sphincteric disturbances in cases of tumor of the temporal lobe and the incidence of such disturbances in cases of tumor of the frontal lobe (charts 2 *B* and 4).

SUMMARY AND CONCLUSIONS

Abnormal mental reactions occurred in 103 cases (94 per cent); this classification does not include transitory abnormal mental states immediately preceding or following the convulsive state and those following operation or intracranial injections of air.

Mental symptoms were the earliest manifestations of tumor in 38 cases (35 per cent), and changes in personality were the first manifestations in 25 cases (23 per cent).

Symptoms referable to the sensorium were most common; next in order of frequency were changes in affect, intellect and higher psychic functions, personality, memory and orientation and sphincteric disturbances.

The most frequent disturbance in affect was irritability; it occurred in 28 cases (26 per cent), in 20 of which the tumor was on the left side of the brain and irritability was associated with some form of aphasia.

Hallucinations occurred in 15 cases (14 per cent). Their significance was considered to be as follows: Hallucinations unassociated with other symptoms are of little localizing value; in psychotic patients and in those with intracranial hypertension they are of no localizing value.

Formed visual hallucinations have some localizing value; their occurrence in association with a defect in the visual fields is confirmatory evidence that the tumor is in the temporal lobe opposite the defect in the fields.

Complex auditory hallucinations appearing before symptoms of intracranial hypertension suggest involvement of the frontal or temporal lobe; their association with formed visual hallucinations or with uncinate phenomena and dreamy states is more in favor of involvement of the temporal lobe.

The association of complex hallucinations with uncinate phenomena, dreamy states and amnesic aphasia is diagnostic of a lesion in the temporal lobe on the dominant side.

Olfactory and gustatory hallucinations associated with dreamy states point to involvement of the uncinate gyrus.*

Except for the relatively greater frequency of irritability and disturbances in intellect in patients with tumor of the left temporal lobe there was no significant difference in frequency and nature between the mental symptoms caused by a tumor of the right and those caused by a tumor of the left temporal lobe.

There was no significant difference between the mental symptoms caused by a tumor involving exclusively the temporal lobe and those caused by one involving the temporal lobe and adjacent structures.

Euphoria was present in 23 patients (21 per cent), facetiousness in 12 (11 per cent), and euphoria and facetiousness in 9 (9 per cent). The incidence of these symptoms in patients with tumor of the temporal lobe almost equaled that previously reported by us for patients with tumor of the frontal lobe.

Except for the greater incidence of complex hallucinations, dreamy states and uncinate phenomena in cases of tumor involving the temporal lobe there was no significant difference in frequency and nature between the mental symptoms of tumor of the temporal lobe and those of tumor of the frontal lobe.

Determining factors in the frequency of occurrence, nature and severity of mental symptoms in the order of their importance are: (1) extent of involvement (direct or indirect) of brain tissue, (2) rapidity of growth, (3) intracranial hypertension, (4) aphasia and (5) the patient's previous mental make-up.

When unassociated with other symptoms mental symptoms are of little value in the diagnosis of a tumor of the temporal lobe. Mental pictures indistinguishable from those found in our patients with tumor of the temporal lobe occur also in aged and arteriosclerotic patients and in patients with other organic disease of the brain, regardless of the nature or location of the disease.

A correlation of the pathologic with the clinical observations in our cases discloses that abnormal mental states cannot be definitely attributed to involvement of any one specific area of the brain. This is in accordance with the generally accepted belief that normal psychic functioning depends on the integrity of the entire brain.

DISCUSSION

Dr. Colin K. Russel, Montreal: Will Dr. Keschner state how the mentality of these patients was studied before operation? In my experience in such cases a diagnosis is made and operation is performed so quickly that there is not much time to judge the various mental states of the patients. One cannot expect to get a fair picture of the mental state after air has been injected into the ventricles.

Dr. Foster Kennedy, New York: I have come to the conclusion that the results Dr. Keschner arrived at are not exactly within my experience, but his material is so carefully worked up and is so extensive that perhaps I should revise some of my ancient conceptions. I had always thought that there was more defect in memory in cases of tumor of the frontal lobe than in those of tumor of the temporal lobe. I have always thought that defect in memory appearing early had localizing value and indicated the existence of a tumor of the frontal lobe. I was surprised, too, to hear that there was no difference in the amount of loss of sphincteric control, as I had always believed that an inability to control the sphincters signified involvement of the frontal lobe. I remember the case of a soldier, shot through the right frontal lobe, who had no organic neurologic signs except failure to control the urinary sphincter. I have thought that visceral control of the sphincters perhaps was localized in the frontal lobe. But if the same problem exists in the cases of tumor of the temporal lobe that Dr. Keschner has accumulated, I must revise these ideas.

I have never thought that the complex hallucinations that occur in cases of an expanding lesion of the temporal lobe had a psychotic significance. They have nothing to do with the mental life of the patient. The greatest mental defect in my experience in cases of tumor of the brain is to be found in those of lesion of the corpus callosum. I wish to ask Dr. Keschner what he means by the statement that mental powers depend on the function of the brain as a whole. I have always rather quarreled with physiologists who use the statement frequently, and in a fashionable manner, that the cortex functions as a whole. I cannot but think that that is a "woolly" statement. What one really means, surely, is that mental power depends on exquisite integration. A savage looking at a motor car would, of course, say that the motor car functioned as a whole, but to say that the cortex functions as a whole because it produces a resultant of forces is to revert to a primitive form of thinking.

The mental ailments associated with tumor of the brain must, I think, have important direct relationship to the size of the tumor, wherever that tumor may be located. I think, as I said, that the greatest mental damage is done by tumors of the corpus callosum; these produce the greatest damage to mental integration, perhaps by interfering with a larger number of association paths than do tumors in other areas. But apart from the corpus callosum as an area, I think that the size of the tumor is probably the determining factor in the production of mental deterioration.

In the cases that Dr. Keschner studied there was a great difference in the number of tumors on the left as compared with the number on the right side. I think there were 41 tumors on the left and 8 on the right side. A person with a tumor of the left temporal lobe has not necessarily a defect in intellect. He has a defect in speech, a jargon aphasia, with usually a quick recognition of his own deficiency. When he speaks, he uses the wrong word; his instruments turn in his hands; he finds himself without his usual facility for communication, and, quite apart from his aphasia, there develops a furious exasperation. That happens in cases of jargon aphasia. The patients are excited, unhappy and exasperated by their own defects, which is a result, I believe, of their loss of a prime facility which they need. Such persons with jargon aphasia are frequently observed in psychopathic departments of general hospitals and regarded as being psychotic, but on analysis they are not really psychotic. They have a jargon aphasia with a sense of deep exasperation as to what has happened to them; this is not of localizing value as representing mental functions in a particular area.

I do not wish to be understood by Dr. Sachs as saying that dreamy states are not indicative of a lesion of the temporal lobe. I believe they are. I must have expressed myself badly if I seemed to say that they are not. What I said was that the hallucinations in cases of lesion of the temporal lobe are not to be considered as psychotic phenomena. That is a different matter.

Dr. Ernest Sachs, St. Louis: When I saw this paper on the program I studied my 84 cases of tumor of the temporal lobe. That is enough, I think,

to compare somewhat the results at the clinic with the findings of Dr. Keschner. One of the features Dr. Keschner mentioned surprised me considerably, that is, the incidence of mental changes in cases of tumor of the temporal lobe; it was higher than the combined incidence of tumors of the right and of the left frontal lobe. In my experience, tumors of the right temporal lobe in right-handed persons practically never produce any mental disturbance unless there is marked increase of intracranial pressure. I have had the idea that in these cases the mental changes were an evidence of general pressure rather than a sign having any local significance.

Then, too, in my series hallucinations of smell, taste or vision have been far more frequent than Dr. Keschner found. He found such hallucinations in only 15 of 110 cases. I have thought that the dreamy states and the hallucinations of smell, taste or vision are of help in localization, particularly in cases of lesion of the right temporal lobe in which the only other evidence ordinarily present on examination is the characteristic field defect. In fact, I have in a few cases believed that the combination in a single patient of disturbances of smell, taste and vision was of real localizing value, and in those cases operation confirmed that opinion, because the lesion was in Wernicke's field. The observation was recorded many years ago by Victor Horsley that when a patient has all three types of hallucinatory phenomena the lesion is far back in the temporal lobe. I still believe, and I am sorry to see that Dr. Kennedy tends to be willing to give up that idea, that the dreamy state is a phenomenon characteristically found in cases of lesion of the temporal lobe. In analyzing his cases, perhaps Dr. Keschner has not differentiated sufficiently between a general pressure phenomenon and one due to the focal pressure centers.

Dr. Thomas K. Davis, New York: Dr. Keschner has brought out more the neurologic than the mental symptoms of tumor of the brain. I do not feel satisfied that he has gone into the minutiae of the mental changes. I wish to ask whether his patients were studied carefuly along psychiatric lines in the early periods of illness or whether the findings were based on, one might say, yes and no answers to questions asked of the relatives.

Dr. Charles H. Frazier, Philadelphia: I believe it is generally acknowledged that mental symptoms per se are not ipso facto localized evidence of tumor of the frontal lobe. I was rather surprised to hear Dr. Keschner say that he had found mental symptoms in 94 per cent of his cases of tumor of the temporal lobe, because in a recent analysis of a series of 105 cases of tumor strictly localized in the frontal lobe, there were only 60 cases in which mental symptoms were found. This ratio is not at great variance with that found in other series, as for example, in that of Dr. Sachs, who reported finding mental symptoms in only 32 of 50 cases of tumor of the frontal lobe, or in that of Dr. Kolodny, who found mental symptoms in only 22 of 37 cases. Perhaps the difference between the figures I have given and the percentage reported by the essayists is due to the fact that in my series the tumors were confined to the frontal lobe. In the abstract of the paper of the essayists on the program, it will be noted that in their series only 32 of 105 tumors were strictly confined to the temporal lobe; in the majority of cases the tumor extended beyond the confines of the lobe. It so happened in my series that parasagittal tumors and those which involved both frontal poles caused mental symptoms in a larger percentage of cases than growths confined to one lobe. What the significance of that may be, I do not know, except that recently considerable importance has been attached to the fact that bilaterality is an important factor in the production of mental symptoms.

Dr. Moses Keschner, New York: In answer to Dr. Russel's question, I wish to state that in only about 10 per cent of the patients in the series which my co-workers and I studied was operation necessary within twenty-four or forty-eight hours after admission. Most of the patients were under observation, either outside of or in the hospital, for at least a week or ten days, and some for as long as a month or more, before they were subjected to any operative procedure.

As to Dr. Davis' question, my co-workers and I did not study the patients' mental states by the "yes or no" method any more than we studied sensation or motion or any other symptom by this method. The cases were investigated carefully by neurologists and psychiatrists, and sometimes when it was thought that special information was needed as to the patient's previous mental endowment psychometric tests were performed.

In answer to Dr. Frazier it may be said that one of the reasons for the investigation of this problem was that we found in the literature great disparity in the occurrence of mental symptoms in patients with tumor of the temporal lobe. One author reported them present in 8 per cent; another found them in 100 per cent of the cases, while most authors reported them in from 60 to 70 per cent. It was this variation that aroused our curiosity.

I am glad that Dr. Kennedy was also impressed by the figures as to the frequency of disturbances of sphincteric control in these cases. We, too, were under the impression that tumors of the frontal lobe are apt to impair sphincteric control much more frequently than lesions of the temporal lobe. Our figures, however, speak for themselves, and we believe that disturbance of sphincteric control is in most instances probably due to intracranial hypertension.

Dr. Kennedy has expressed our idea, though much better than we did, when we said that normal psychic functioning depends on the integrity of the entire brain. I believe his statement that "it depends on exquisite integration of the entire brain" contains the idea we attempted to convey.

As far as tumors of the corpus callosum are concerned, we found no cases in our series in which the corpus callosum alone was involved. In all cases in which the corpus callosum was affected there was also involvement of either the frontal or the temporal lobe, or else the tumor was so huge that the corpus callosum was also implicated. We could therefore draw no definite conclusions. We believe, however, that the interruption of the association pathways in the corpus callosum plays an important rôle in the production of mental symptoms in cases of tumor in this region.

I am glad that Dr. Sachs discussed the question of hallucinations, because this was another reason for undertaking our study. We delved into the problem of hallucinations carefully because we were under the impression that hallucinations are much more frequent than we found them in our series. We found only 15 patients with hallucinations. This may possibly be due to the fact that it takes unusual intelligence on the part of a patient to describe a complex auditory hallucination or a formed visual hallucination. To the average layman the difference between hearing sounds and voices or seeing objects or flashes of light is not of sufficient interest to enable him to describe them in detail. Strangely, only 2 of the patients with hallucinations also had the dreamy states—the classic dreamy states—described by Hughlings Jackson. This may also possibly be due to the difficulty of eliciting a description of such states and evaluating them, especially when the patients on admission had marked intracranial hypertension or were psychotic. A description of hallucinations or dreamy states by such patients had to be disregarded.

In conclusion, we believe that in studying a problem of this type a great deal depends on who examines the patients, how they are examined and whether special attention is paid as to whether the patients present abnormal mental states. We believe that when the problem is attacked from this point of view one will find that approximately 90 per cent of the patients with tumor involving the temporal lobe show abnormal mental reactions.

RESULTS OF ROENTGEN TREATMENT OF A SERIES OF ONE HUNDRED AND NINETEEN GLIOMAS

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We have been treating many of our patients with roentgen radiation after operation for tumor of the brain. We have wondered what we were accomplishing and whether we should continue to follow the technic we now use or whether, on the basis of a review of the cases, we should make changes in the treatment. In the past eight years we have employed a fairly uniform technic, which has been planned by Dr. Sherwood Moore.

TECHNIC

The method employed has been essentially the same in each instance. Radiation has been delivered to the tumor bed through at least two surfaces of the head. The ports have usually been over the right and left sides, but if a cerebellar lesion was present a field directly over the occiput was often used. Single exposures have been delivered to each area, only one field being treated on one day. The dose has been repeated at intervals of six weeks, whenever possible, until each area has received three treatments. The first exposures have been given about two weeks after operation.

Radiation has been delivered from a 200 kilovolt machine (constant potential since 1931), operating at 15 milliamperes. A 50 cm. target-skin distance and a filter that consisted of 1 mm. of copper and 1 mm. of aluminum have been used. Each port has been 12 by 12 cm., with the beam centered over the tumor bed and directed straight through to the opposite side. The average dose delivered at each exposure has been about 800 to 825 roentgens, including backscattering. (Measurements were made with a Victoreen instrument, the chamber being completely submerged in a paraffin phantom. The same dose measured in air has been found to be about 450 roentgens.) This dose has been sufficient to cause epilation in the irradiated area; however, in every instance the hair has returned after treatment was completed. Most of the patients have shown a faint erythema. The amount of radiation delivered at each exposure may therefore be described as being slightly more than a threshold erythema dose for the size of the skin field and for the quality of radiation that has been used. (A threshold erythema

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dose has been defined by Quimby [1] as representing an amount of radiation that will produce a visible reddening of the skin within four weeks after the exposure in 80 per cent of the patients so treated but no visible reaction in the remaining 20 per cent.

More data pertaining to the method used in the treatment of these patients have recently been obtained on a water phantom. Measurements were made on the surface and at various depths with a Victoreen instrument. The chamber was placed in the axis of the beam and for the surface reading was half submerged. It was found that 46 per cent of the surface radiation was obtained at a depth of 8 cm. This depth would probably correspond to the distance from the surface of the scalp over the parietal bones to the middle of the brain in the average patient. In order to obtain a more accurate estimate of the percentage of the surface radiation reaching the middle of the cranial cavity, another reading was made with the top of a skull placed just beneath the surface of the water and directly over the chamber. It was then found that only 43 per cent of the surface radiation was obtained at a depth of 8 cm. From these data we estimate that the middle of the cranial cavity received about 43 per cent of the dose delivered to each side of the head when treated in the manner described. When both treatments were given that region would have received about 86 per cent of the surface dose. Since the amount of radiation delivered to each area of skin probably represents a little more than a threshold erythema dose, we conclude that the middle of the brain had received about one threshold erythema dose when each cycle of treatment was completed. It must be remembered that estimates of tissue dose are only approximate under any circumstance.

Pancoast [2] has published data showing a tumor dose totaling from 105 to 115 per cent of the surface radiation when three fields were used, each measuring 6 to 8 cm. The reactions noted in the skin of the scalp were apparently comparable to those observed in the present series. However, the radiation was not necessarily delivered by the same method as that employed in this clinic. In a report published by Bailey, Sosman and Van Dessel,[3] it is stated that roentgen rays generated by a machine of 140 kilovolt peak had been used, with a depth dose of only from 17 to 21 per cent obtained 10 cm. beneath the surface of a water phantom.

Sgalitzer,[4] Störmer and Gotthardt,[5] Backmund [6] and Heinismann and Czerny [7] have reported reactions in the scalp similar to those noted in

1. Quimby, E. H.: The Skin Erythema Dose with a Combination of Two Types of Radiation, Am. J. Roentgenol. **17**:621, 1927.

2. Pancoast, H. K.: Experience in the Treatment of Brain Tumors by Irradiation During the Past Thirteen Years, Am. J. Roentgenol. **19**:1, 1928.

3. Bailey, P.; Sosman, M. C., and Van Dessel, A.: Roentgen Therapy of Gliomas of the Brain, Am. J. Roentgenol. **19**:203, 1928.

4. Sgalitzer, M.: Neue Erkenntnisse auf dem Gebiete der Röntgenstrahlenwirkung bei Hirntumoren, Strahlentherapie **22**:701, 1926.

5. Störmer, A., and Gotthardt, P. P.: Zur Röntgenbehandlung der Hirntumoren, Strahlentherapie **29**:678, 1928.

6. Backmund, K.: Weitere Erfahrungen mit der Röntgenbehandlung der Hirntumoren, Strahlentherapie **37**:59, 1930.

7. Heinismann, J. I., and Czerny, L. I.: Zur Frage nach der Röntgentherapie der Gehirntumoren, Strahlentherapie **40**:302, 1931.

the present series. Some authors may have used greater amounts of radiation over a particular cycle than have been employed in this clinic, but these doses have usually been fractionated into several exposures. Methods of treatment have also been described in which the cycles were repeated more frequently than at intervals of six weeks. Although the total amounts of radiation have been different and the time over which the dose was delivered has varied, the fact that nearly all authors have made the comment that epilation but only a faint erythema was produced by the treatment indicates that the biologic reaction occurring in the skin has been about the same for the different methods. The conclusions usually drawn have been that greater doses are indicated if the patients can withstand the effects of additional treatment. Béclère [8] expressed the belief that fractionated doses will prove more satisfactory. In all probability reports showing the effect of greater doses on large series of patients will soon begin to appear in the literature.

As it is established, we believe, that fibroblastic tumors, either meningeal fibroblastomas or perineurial fibroblastomas, are not at all influenced by roentgen therapy, we have included in this study only the various types of gliomas. During that period we observed 196 verified gliomas and 17 hemangioblastomas; 119 of these tumors were treated with roentgen radiation. The general principle followed at the clinic has been to remove a tumor as radically as possible and then administer roentgen therapy as soon as possible. In analyzing our results we have encountered the same difficulty that other observers have had in deciding how much improvement could be attributed to the roentgen therapy and how much had to be ascribed to the operative procedure which preceded the roentgen treatment. It is well known that after roentgen therapy has been applied a tumor swells and becomes edematous. This is strikingly seen in cases of pituitary tumor, in which the ocular fields may contract markedly during the first two weeks after treatment and then spread out as the edema subsides. This is undoubtedly what also occurs if a patient with a tumor is treated without operation. This point was brought up by Bailey, Sosman and Van Dessel [3] in an article published in 1928. If a tumor is extirpated as completely as possible, or if a considerable part of a tumor has been removed, so that there is a defect of considerable size, there will be no danger from the swelling which follows. Since as complete removal as possible was the procedure we followed, not a single instance of alarming symptoms following therapy occurred in our group of patients with glioma.

Our criterion of determining the effect of roentgen radiation has been as follows: If after receiving roentgen treatment a patient showed

8. Béclère, A.: Die Strahlentherapie der Hirntumoren, Strahlentherapie **42**: 870, 1931.

definite subsidence of symptoms which were still present after the tumor had been extirpated, we considered that some beneficial effect had resulted from the therapy. To judge the results by comparing the average length of life of a group of patients who had been operated on but had received no roentgen treatment with that of a group that have been operated on and had received roentgen treatment is misleading and is, we believe, an unreliable way of drawing conclusions.

For example, we do not believe that roentgen therapy is of value in the treatment of astrocytomas. We have, however, in the past eight years treated 21 patients with astrocytoma with roentgen radiation. By comparing the average length of life of these patients with that of the 22 patients in this series who were discharged from the hospital without receiving such treatment, we find that the average length of life of the patients treated with roentgen radiation is somewhat longer than that of those not so treated, but to deduce from this that the roentgen treatment was responsible for the difference would be an error. As one studies the case histories it becomes obvious that the completeness of the operation was responsible for the final result. If the nubbin of tumor in an astrocytoma is not completely extirpated, sooner or later the patient will have a recurrence. When the neoplasm has been completely removed, the patient remains permanently well. We have patients who have been well for more than two hundred and forty months (twenty years), and a considerable number have remained well for more than eight years; yet the figures in this paper are based only on the results obtained in the last eight years, as it is only since then that we have used the amount of roentgen therapy described earlier in this paper.

The tumors have been grouped according to the classification used first in the clinic of Cushing and now in general use.[9] It would be absurd to speak of the results of roentgen therapy on all gliomas, for some types are unaffected, some are definitely inhibited in growth and it may be that others are stimulated. On the latter point we are unable to express a definite opinion. After a tumor has had a certain amount of roentgen radiation it may become resistant to such treatment and may continue to grow rapidly, but whether it is actually stimulated, made more malignant, is a different question.

MEDULLOBLASTOMAS

First, we shall consider tumors which seem to be definitely affected by roentgen radiation. As was pointed out by Bailey, Sosman and

9. Bailey, P., and Cushing, H.: A Classification of Tumors of the Glioma Group on a Histogenetic Basis, with a Correlated Study of Prognosis, Philadelphia, J. B. Lippincott Company, 1926.

Van Dessel[3] and by Alpers and Pancoast,[10] medulloblastomas are definitely influenced by roentgen therapy. In our series there were 35 cases of medulloblastoma, in which 52 operations were performed. The mortality rate on the basis of the number of cases was 28.5 per cent and on the basis of the number of operations, 19.2 per cent. Of the patients operated on but not receiving roentgen therapy, 1 patient lived seven months and all the others died within a shorter time. In the group radically operated on and receiving roentgen therapy 1 patient (case 1) lived fifty-four months; 1 (case 2) is still living at the end of thirty-seven months; 1 (case 3) lived twenty-nine months, 1 (case 4) is still living at the end of seventeen months, and 1 (case 5) is still living at the end of fourteen months.

CASE 1.—C. E. J., a man aged 38, who was referred by Dr. W. C. Simmons, of Smith's Grove, Ky., was admitted to the Barnes Hospital on Dec. 10, 1929, with disturbance in gait and headache of eight weeks' duration. He had had some headache for a year, but definite symptoms began only eight weeks before, when there developed staggering gait and intense headache. Three days before admission the patient became somewhat stuporous, and speech became slow. A spinal puncture had been done shortly before the patient was hospitalized, and it undoubtedly aggravated the symptoms.

The positive findings were: mental stupor, confusion and disorientation; a high grade of bilateral choked disk, with hemorrhages and exudate; lateral nystagmus to the right, and a bilateral Oppenheim sign. When the patient tried to raise himself from the bed his head fell forward and he began to have focal convulsive movements in the right arm and leg. A few spots in the roentgenogram of the skull suggested a metastatic process, but roentgenograms of the lungs showed normal conditions. A ventriculogram made just before the operation showed dilated lateral and third ventricles.

On Dec. 13, 1929, a well encapsulated tumor was removed from the right cerebellar hemisphere. It was attached to the under-surface of the tentorium and weighed 26 Gm. The patient made an uneventful recovery.

The tumor was a medulloblastoma (fig. 1; this diagnosis was confirmed by Dr. Percival Bailey).

The patient returned a year later because the cerebellar wound had been bulging for the past month. The margins of the disks were hazy; there were marked cerebellar herniation, ataxia and adiadokokinesis and lateral nystagmus, more marked to the right than to the left.

On Dec. 17, 1930, at a second operation, a huge recurrent growth was found; it was impossible to remove all of it as some extended forward under the tentorium.

Roentgen treatment was given before the patient left the hospital and was continued intensively afterward. After each treatment the patient reported improvement; he was able to attend to business.

He remained well until May 13, 1933, when he returned because of an enlargement over the sternum. Biopsy revealed the same kind of tumor that had been removed from the cerebellum (fig. 2). Roentgen therapy was given, and the

10. Alpers, B. J., and Pancoast, Henry K.: The Effect of Irradiation on Normal and Neoplastic Brain Tissue, Am. J. Cancer **17**:7, 1933.

mass promptly disappeared. The patient remained in excellent condition until Feb. 8, 1934, when he returned complaining of symptoms of involvement of the cord. A complete block was revealed by the Queckenstedt sign; yellow fluid and all the symptoms of a spinal involvement were present. Roentgen treatment was given to the spine, but the patient continued to fail; he died on June 18, 1934. Autopsy was not performed.

Roentgen Treatment.—The patient received the first course of roentgen treatment in December 1930. This was repeated six weeks later. The tumor bed may be said to have received about 2 threshold erythema doses in that course of

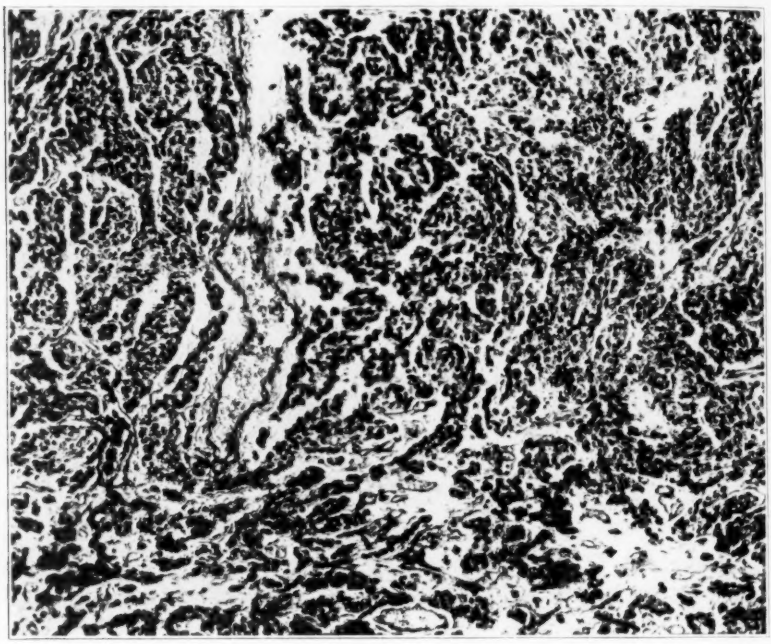

Fig. 1 (case 1).—Section of tumor removed from the cerebellum. A nodule removed later from the sternum presented exactly the same appearance.

treatment. Three years later an additional threshold erythema dose was delivered to the same region. In addition, the patient also received a total of eight exposures to the spine. These were delivered at intervals of from four to twelve months.

This patient clearly derived a beneficial effect from roentgen therapy. The appearance of a metastatic nodule over the sternum naturally raised the question whether the pathologic diagnosis was correct, but similar cases have been reported in the literature by Cairns,[11] and we have therefore kept the case in this group.

11. Cairns, Hugh, and Russell, Dorothy S.: Intracranial and Spinal Metastases in Gliomas of the Brain, Brain **54**:377, 1931.

CASE 2.—G. E. D., a man aged 21, who was referred by Dr. T. H. Romeiser, of Springfield, Mo., was admitted to the Barnes Hospital on March 3, 1932, because of frontal headache, roaring in the head and difficulty in walking; these disturbances had been present for one month. Ten days before admission the symptoms were so severe that the patient had to remain in bed. Attacks of intense vomiting began four days before admission, and after they occurred drowsiness developed. The day before admission the patient had an attack that suggested a convulsion due to involvement of the cerebellum.

The picture was typical of that produced by a lesion of the posterior fossa: There were a high grade of choked disk with exudate and hemorrhage, marked hypotonia in the lower extremities, adiadokokinesis of the right hand, marked

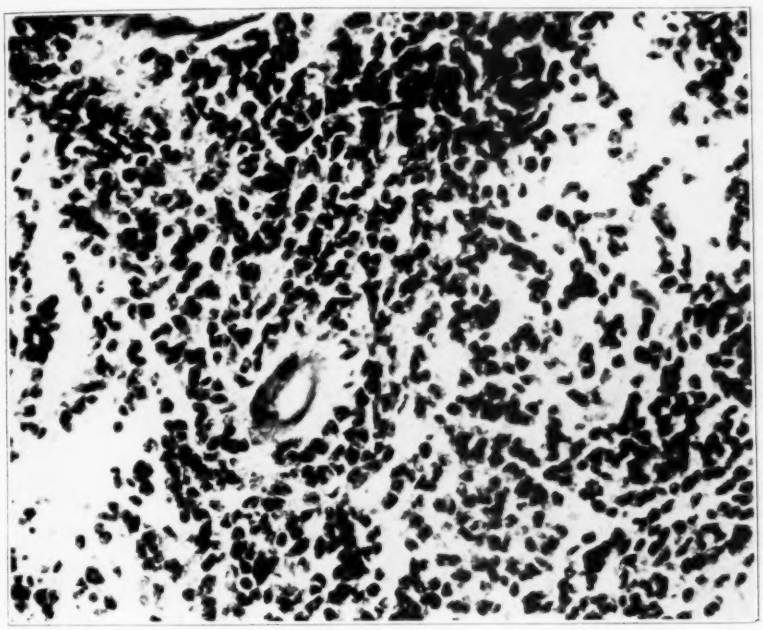

Fig. 2 (case 3).—Section of tumor removed at operation.

lateral and vertical nystagmus and some dysarthria. There was evidently a tumor, fairly far forward, pressing on the corpora quadrigemina.

On March 7, 1932, a cerebellar craniotomy was performed. As the pulse rate had dropped to 45, the operation was performed as an emergency procedure. At a preliminary ventricular puncture a large amount of fluid escaped, and the pulse rate rose to 65. A tumor, weighing 17.5 Gm., filling the fourth ventricle, was removed. It extended into the aqueduct of Sylvius, which was markedly dilated. The patient made an uneventful recovery. The muscle suture, however, gave way and a hernia developed; on April 19, 1932, this was repaired with a large fascial transplant. The patient was discharged on May 29, 1932.

The tumor was a medulloblastoma.

Roentgen Treatment.—The first roentgen treatment to the tumor bed was given in May 1932. At that time the tumor bed received approximately 1 threshold

erythema dose. This amount of radiation was repeated eleven months later. In addition, the patient received two exposures to the spine in October 1932. Two additional treatments were given to the spine three months later.

Subsequent Course.—When last heard from, the patient was working and had had no recurrence of symptoms.

CASE 3.—C. P., a youth aged 16, who was referred by Dr. Lucien Gaudet and Dr. H. M. Smith, of Natchez, Miss., was admitted to the Barnes Hospital on June 15, 1932, complaining of failing vision and staggering gait, which had been present for seven months. The first symptom was diplopia. Shortly after this failing vision was noticed. Because of a positive Kahn reaction prolonged antisyphilitic treatment had been given. Five months before admission there were marked bilateral choked disk and attacks of convulsions of cerebellar origin, evidenced by retraction of the head and convulsive movements of all four extremities. When walking the patient tended to fall backward, and for the past four months he had been practically bedridden. The convulsive seizures occurred about once a week. He had vomited frequently. Three months before admission an encephalogram was made at another clinic and a diagnosis of inoperable tumor of the brain was made.

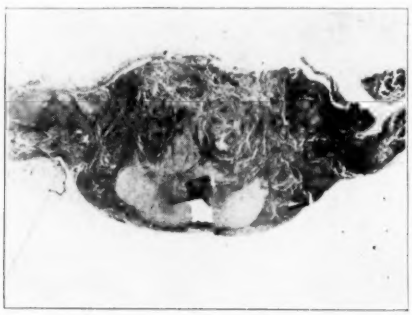

Fig. 3 (case 3).—Section of the spinal cord, showing tumor meningitis with infiltration of the cord by the tumor cells.

The physical signs on admission were: diplopia, failing vision, "cerebellar fits," a tendency to fall backward, high grade of bilateral choked disk, lateral nystagmus, increased reflexes and well sustained patellar clonus on the right. The findings were typical of the manifestations produced by a lesion of the posterior fossa. Roentgenograms showed markedly increased pressure, and the dorsum sellae was pushed forward and partially absorbed. The picture was so characteristic that a ventriculogram was not deemed necessary.

On June 17, 1932, a cerebellar craniotomy was performed. A large tumor which plugged the iter and filled the floor of the fourth ventricle was removed, partly with suction and partly with the electric knife. The tumor weighed 7 Gm. (fig. 3). At one point, in dissecting the tumor from the edge of the medulla with the electric knife, a sharp contraction of the left shoulder was obtained; hence at this point a small bit of tumor tissue was left.

The tumor was a medulloblastoma.

The patient had some postoperative fever, which subsided. A small hernia developed, which was repaired on July 11, 1932. Roentgen treatment was given, and the patient was kept under close observation by his physician. The

patient was readmitted on Dec. 4, 1933. After roentgen treatment two months before admission, he had become violently ataxic in both arms and legs. Spinal puncture showed clear fluid and no block. He was advised to submit to another operation but refused. Further roentgen therapy was given, and the symptoms subsided.

The patient was readmitted on Jan. 22, 1934, when he still showed some symptoms of cerebellar involvement, but they were distinctly better; there was no herniation of the wound; further roentgen treatment was given. After he had returned home his physician reported that he was getting along well, but in August 1934 he was readmitted, because of pain in the back, disturbance in the sense of position in the toes and urinary symptoms—disturbances evidently due to a spinal

Fig. 4 (case 3).—High power magnification of tissue from the spinal cord, showing invasion by tumor cells.

metastasis. Roentgen treatment was given again, without improvement, and the patient died on Nov. 24, 1934.

Autopsy showed a small recurrence in the cerebellum, but the entire spinal cord was involved in a tumor meningitis (fig. 4).

Roentgen Treatment.—The first course of roentgen treatment delivered to the tumor bed was given in December 1933. In the ensuing eight months, three additional courses were administered. The tumor bed received approximately 4 threshold erythema doses during that period. In addition, the patient received thirteen treatments to the spine. The first of these was administered in July 1932. (Five of the ensuing treatments were given by Dr. James C. Rice, of Natchez, Miss.) The treatments were given at intervals of from one to ten months during a period of twenty-six months.

Case 4.—J. G. Jr., a boy aged 11 years, was admitted to the Missouri Pacific Hospital on Oct. 16, 1933, with severe headache, dizziness, nausea and vomiting. The illness began in December 1932 with discharging ears; a diagnosis of mastoiditis was made but operation was not performed. There were perforations in both tympanic membranes with a profuse discharge of pus, lateral nystagmus to both sides, vertical nystagmus, a high grade of bilateral choked disk, a tendency to fall to the left and backward, slight facial weakness on the left side and adiadokokinesis of the left hand.

A cerebellar abscess was suspected.

On Oct. 27, 1933, through a small incision on each side, each cerebellar lobe was explored with a needle, but no abscess was found.

The symptoms continued to increase, and on Nov. 8, 1933, a ventriculogram was made; it showed a picture typical of that produced by a lesion of the posterior fossa. A cerebellar craniotomy was performed immediately, and a tumor weighing 40 Gm. was dissected out of the fourth ventricle. The tumor had plugged the iter. The aqueduct of Sylvius was greatly dilated. A small blood transfusion was given.

The tumor was a medulloblastoma.

The patient made an uneventful recovery, but two weeks later acute appendicitis developed. The appendix, removed by Dr. A. O. Fisher, was full of blood; this suggested the possibility of association with the lesion of the fourth ventricle. The patient was discharged on Dec. 8, 1933.

Roentgen Treatment.—The first treatment to the tumor bed was given in December 1933. During the ensuing twenty-five weeks two additional courses were given. The tumor bed may be said to have received approximately 3 threshold erythema doses in that period. Ten months after the last treatment an additional course was administered, so that an additional threshold erythema dose was delivered to the tumor bed. In addition, two exposures to the spine were given in December 1933.

Subsequent Course.—Thus far the patient has been free from symptoms.

Case 5.—J. W. L., a man aged 25, who was referred by Dr. J. W. Goode and Dr. Joe Kopecky, of San Antonio, Texas, was admitted to the Barnes Hospital on Jan. 29, 1934, complaining of headache which had been present for the past month. The patient had not felt well for the past four to six months. There had been no definite symptoms until a month before admission, when he began to suffer from headache, dizziness and staggering gait. He thought he staggered more to the right. Weakness became so marked that he had been confined to bed for two weeks.

Physical examination showed a peculiar clumsiness of the right hand, with marked ataxia and adiadokokinesis of this hand; facial weakness and an Oppenheim sign and ankle clonus on the right side; marked weakness of grip of the right hand; a bilateral Babinski sign; peculiar drawling speech, and loss of convergence. The eyegrounds were normal; the pupils were markedly dilated but reacted to light.

The picture suggested a cerebral lesion rather than a lesion of the posterior fossa, and therefore a ventriculogram was made on Feb. 3, 1934. This showed bilaterally dilated ventricles and a dilated third ventricle, indicating that evidently the lesion was in the posterior fossa. A tumor in the right cerebellar hemisphere was uncovered; it extended up under the tentorium; it was removed by suction and weighed 11 Gm.

The tumor was a medulloblastoma.

The patient made an uneventful recovery. The weakness of the right hand disappeared, and he was discharged on Feb. 21, 1934.

Roentgen Treatment.—One course of roentgen treatment (approximately 1 threshold erythema dose delivered to the tumor bed) was given in February 1934. Dr. C. F. Lehman of San Antonio, Texas, began treating the patient three months later. He delivered a total of six exposures of from 160 to 350 roentgens to the patient's head during a period of seven months. Two treatments were given to the spine in February 1934.

Subsequent Course.—The last report was that the patient was in good condition and thus far had had no return of symptoms. (After this paper was written the patient had a marked return of symptoms of cerebellar involvement, which completely disappeared with roentgen therapy. The patient is again back at work.)

In reviewing the operative notes on these cases we find that it was in this group that the most thorough extirpation had been done. The patient who lived twenty-nine months was found at autopsy to have a small local recurrence in the cerebellum which had caused no symptoms and an extensive tumor meningitis all the way down the cord. This patient (case 3) had had a recurrence of symptoms of cerebellar involvement seventeen months after the operation. He received two roentgen treatments at that time, at intervals of six weeks, and was free from symptoms for nine months. Then there appeared signs of involvement of the spinal cord which were not influenced by a further roentgen treatment. He died three months later. The patient who lived fifty-four months had a recurrence in ten months after the first operation and was operated on again one year after the first operation. A radical extirpation gave complete relief for thirty months. At that time he was given roentgen therapy, which relieved him for eight months, then he returned with signs of involvement of the spinal cord. The patient who is still well at the end of thirty-seven months (case 2) received four roentgen treatments at six week intervals. From observations on this group we have drawn the following conclusions:

1. In order to obtain the best results from roentgen therapy, irradiation should be preceded by a radical operative removal.

2. High voltage therapy prolongs the life of patients with medulloblastoma.

3. If roentgen radiation has such a definite effect on this type of tumor it would seem logical and justifiable to increase the amount of roentgen therapy and thus attempt to destroy any remaining tumor cells. We are just beginning to do this by giving therapy through multiple portals of smaller size; this enables us to deliver a greater total dose to the tumor bed. The other method to be considered is to give therapy into the open wound at the time of operation. If such a technic can

be applied much larger doses can be given. At present Dr. Moore is doing this in cases of malignant disease of the neck and bladder. The stumbling block heretofore has been the obstacle presented by the skin and bone. We have as yet not seen our way clear to making use of this method on account of the danger of infection.

HEMANGIOBLASTOMAS

The second group of cases in which, we believe, roentgen therapy has given good results are those of hemangioblastoma. There were 17 patients in this group; 9 received roentgen treatment and 8 did not. It is true that the 2 patients who survived the longest received no roentgen treatment; both of them are still living seventy-one months after operation. One had a solid tumor in the fourth ventricle; the other, a cerebral cyst with a nubbin in its wall. This second patient was operated on for a recurrence fifty-two months after the first operation. Of the other 6 patients who are living and were treated with roentgen radiation, 1 (case 6) has lived fifty months after operation; another (case 7), twenty-nine months; 2 (cases 8 and 9), twenty months, and 2 others a shorter time.

CASE 6.—J. G. A., a man aged 38, who was referred by Dr. G. W. Parson and Dr. N. B. Daniel, of Texarkana, Texas, was admitted to the Barnes Hospital on May 30, 1931, because of headache, dizziness and general weakness. Ten months before there had been intense headaches, which gradually improved. One month later the patient began to have spells of dizziness associated with semiconsciousness and a peculiar unpleasant taste. After these attacks he was exhausted. The attacks became more frequent. Some change in personality occurred. Shortly before admission to the hospital he noticed difficulty in seeing objects on the left side.

Physical examination showed bilateral choked disk; tenderness over the right side of the head in the temporal region; left homonymous quadrantal hemianopia, and facial weakness, weakness of the left arm and leg, poorly sustained ankle clonus and a suggestion of a Babinski sign on the left side. The picture was typical of that produced by a lesion of the left temporal lobe. On June 2, 1931, a cerebral craniotomy was performed, and a cyst containing between 70 and 80 cc. of fluid was found; there was a solid tumor in its wall, which weighed 6 Gm. and occupied the tip of the temporal lobe. The entire temporal lobe was resected. This was a long procedure, and in the afternoon the patient was given a blood transfusion.

The tumor was a hemangioblastoma.

The patient made an uneventful recovery and was discharged on June 15, 1931.

Roentgen Treatment.—A single course of roentgen treatment was given in July 1932. The tumor bed received approximately 1 threshold erythema dose over the two days required for delivering the radiation. The patient continued to have attacks of disorders referable to the temporal lobe and received subsequent treatments in October 1932 and in May 1933 from Dr. S. C. Barrow of Shreveport, La.

Subsequent Course.—When last seen the patient was perfectly normal; the visual fields had become normal, and the attacks of disorders referable to the temporal lobe had practically disappeared.

CASE 7.—L. R. B., a girl aged 12 years, who was referred by the Shriners Hospital for Crippled Children, was admitted to the St. Louis Children's Hospital on Feb. 22, 1933, because of failing vision and inability to walk. Five months before she had fallen and struck her head. Since that time she had had intense headache and difficulty in walking. When she was placed on her feet she had a tendency to fall backward.

Physical examination revealed: a marked Macewen sign; subsiding bilateral choked disk with secondary atrophy of the optic nerves; lateral nystagmoid movements; weakness of the right sixth nerve; weakness of the right side of the face, and ankle clonus and inconstant Babinski and Oppenheim signs on the right side. The patient showed a slight tendency to fall backward when she was standing.

On Feb. 27, 1933, a cerebellar craniotomy was performed and a large cyst which contained about 300 cc. of fluid was encountered in the left cerebellar lobe; at the bottom was a nubbin of tumor about the size of a horse-chestnut. The nubbin weighed 19 Gm. The tumor was a hemangioblastoma.

Roentgen Treatment.—A single course of roentgen treatment was given in March 1933. The tumor bed received approximately 1 threshold erythema dose over the two days required for delivering the radiation.

CASE 8.—L. B. P., a woman aged 40, who was referred by Dr. H. J. Davis, of Topeka, Kan., was admitted to the Barnes Hospital on Jan. 13, 1934, because of attacks of jerking in the left leg. Two years before there was loss of control of the left leg. In September 1932 slight twitching of the left leg was noticed. Two months later the patient had a convulsion which involved the left leg. These attacks had recurred every month since, and sometimes as many as seven convulsions occurred in succession. There was never any loss of consciousness. Later the patient complained of headaches and double vision. Vision had been gradually failing, and she had been totally blind in the left eye for the past five weeks. The patient had observed a peculiar disturbance in smell in the past two months. She thought she smelled a gaslike odor, which was difficult to describe.

The results of examination were as follows: diminution of the sense of smell; a high grade of bilateral choked disk, and blindness, weakness of the sixth nerve, facial weakness, diminution of the abdominal reflex and positive Babinski and Oppenheim signs on the left side. A ventriculogram showed that the left and third ventricles were deformed and pushed to the right and that no air was present in the right ventricle.

On Jan. 16, 1934, a cerebral craniotomy on the right side, exposing both the parietal and the temporal lobe, was performed; a tumor was found in the leg center just under the longitudinal sinus; it was not larger than a walnut.

The tumor was a hemangioblastoma.

Recovery was satisfactory, though the patient still complained of hallucinations of smell. After operation there was a partial paralysis of the leg, which, however, improved markedly before the patient left the hospital.

Roentgen Treatment.—Before the patient left the hospital a single course of roentgen treatment was given in January 1934.

The tumor bed received approximately 1 threshold erythema dose over the two days required for delivering the radiation. Since then similar doses have been administered in March and May 1934 by Dr. Owen and Dr. Finney, of Topeka, Kan.

Subsequent Course.—Symptoms referable to the temporal lobe have disappeared.

Case 9.—A. V. S., a woman aged 44, who was referred by Dr. D. V. Conwell of Halstead, Kan, was admitted to the Barnes Hospital on Jan. 17, 1934, because of headache and ringing in the ears. From 1926 to 1928 she had been treated for thyroid disease; her weight had increased from 145 to 205 pounds (65.8 to 93 Kg.). A year before admission to the hospital she began to complain of ringing in the ears, pain in the head and numbness of both arms and hands. Six months later she complained of spells of dizziness and pain in the left side of the head. Two months before admission she had a severe headache associated with vomiting, and following this she had numbness on the left side of the face, which persisted until her entrance into the hospital. In the past few months she had lost memory for names.

Examination showed a high grade of bilateral choked disk with huge hemorrhagic areas; slight facial weakness on the right side; a Babinski sign on the left side; patellar clonus on both sides, more marked on the left, and tremor in both hands. Roentgenograms showed changes in the frontal region of the skull.

As the symptoms were bilateral, a ventriculogram was first made. The ventricles were markedly collapsed and showed displacement to the right, indicating a lesion of the left frontal region. On Jan. 20, 1934, a frontal craniotomy on the left side was performed. A solid tumor lying on the corpus callosum and extending into the left frontal lobe was removed. One piece of tumor tissue which was attached to the falx had to be excised with the falx. The tumor weighed 31 Gm.

The tumor was a hemangioblastoma.

The patient made an uneventful recovery and was discharged on Feb. 3, 1934. The symptoms have disappeared entirely. The slight disturbance of speech which was present when the patient left the hospital has disappeared, but she has had a convulsion occasionally.

Roentgen Treatment.—Before the patient left the hospital a single course of roentgen treatment was given. The tumor bed received approximately 1 threshold erythema dose over the two days required for delivering the radiation. After she received this dose the patient was under roentgen treatment by Dr. Opie W. Swope, of Wichita, Kan., on seven different occasions. Each treatment consisted of a series of exposures delivered over a period of from three to nine days.

The reason we believe that roentgen radiation has been of value is that 3 of these 4 patients showed definite symptoms after operation and these symptoms have disappeared after therapy and thus far have not recurred. Here again, however, we wish to emphasize that we believe that preliminary radical extirpation is an important factor in the ultimate result. Another factor which no doubt should be considered in this group of cases as well as in cases of other types of tumor is the degree of malignancy. One case in this group illustrated this point strikingly. The patient had a large hemangioblastoma, which was removed, we thought, completely. She received the usual dose of roentgen radiation but had a rapid recurrence in two months. A second operation with therapy was of no avail, and the patient died two months later.

Case 10.—L. J. D., a woman, aged 25, who was referred by Dr. W. A. Clark, of Jefferson City, Mo., was admitted to the Barnes Hospital on Jan. 20, 1932,

because of convulsions for the past four or five years. About six months before admission to the hospital she first noticed slowing in speech, which in the last three months had become so marked that others noticed it.

Physical examination revealed: a high grade of choked disk with evidence of hemorrhages and much exudate; a tender area over the left frontal region; facial weakness and weakness of the arm and leg on the right side; loss of memory for names and some aphasia of the motor type, and a bilateral Oppenheim sign. The other reflexes were normal. Roentgenograms showed destruction of bone in the left frontal region. The preoperative diagnosis was meningeal fibroblastoma.

On Jan. 25, 1932, a frontal craniotomy on the left side was performed. A soft tumor, partly cystic, was found in the left frontal lobe and was removed partly by suction and partly by electrocoagulation. It weighed 70.5 Gm. The patient was given 900 cc. of blood; she made an uneventful postoperative recovery.

Examination of the tumor showed a hemangioblastoma which in places looked like a meningeal fibroblastoma.

Three months after operation the patient returned with the flap markedly elevated and a tense hernia; evidently there was a recurrence.

On April 2, 1932, a second operation revealed a huge recurrence which was removed as thoroughly as possible; it was thought, however, that not all of the tumor had been removed. The tumor weighed 105 Gm.

Rapid recurrence took place, and the patient died two months later.

Roentgen Treatment.—The patient received a single course of roentgen treatment in April 1932. The tumor bed received approximately 1 threshold erythema dose over the two days required for delivering the radiation.

GLIOBLASTOMAS

The group in which roentgen therapy seems to have only a temporary but definitely inhibitory influence consists of the cases of spongioblastoma multiforme, now called glioblastoma. There were 45 cases in this group; in 17 of them roentgen therapy was given. No cure resulted in this series, but we have repeatedly seen a recession of symptoms when a patient returned with a recurrence. There are 3 cases in this series that illustrate this inhibitory effect strikingly. One patient (case 11) lived thirty-five and one-half months, 1 (case 12) lived twenty-one months and 1 lived seventeen months. That is longer than patients with such a tumor live ordinarily. According to our experience they usually succumb in from ten to fourteen months. In each of the 3 cases mentioned the improvement after each treatment was striking, and in others, though the patient did not live long, temporary improvement was observed.

Case 11.—F. H. M., a man, aged 43, was admitted to the Barnes Hospital on Dec. 9, 1926, because of an attack of unconsciousness and headache. Two months before he had awakened during the night stating that he was feeling ill, and shortly thereafter he had lapsed into unconsciousness, which lasted for three days. There were no convulsions during that time. When the patient regained consciousness he complained of headache, which gradually increased in severity. In the last month there had been twitchings of the left side of the face and double

vision occasionally. Recently the patient had difficulty in naming objects. There had been a definite change in personality; he was uninterested in his surroundings, had lost interest in his family and had shown marked increase in irritability.

Physical examination revealed: facial weakness on the right side; some disturbance in speech, somewhat of the nature of paraphasia; hypesthesia on the right side of the body, and pathologic toe signs on the right side. Otherwise there were no abnormalities. Roentgenograms showed a lesion in the bone on the left side. The eyegrounds showed slight change; there was a little haziness of the right disk but no definite choking.

The patient refused operation but returned nine days later; at that time there were hemorrhages in the left disk and some tortuosity of the vessels.

On Dec. 29, 1926, a frontoparietal craniotomy on the left side was performed, and a soft tumor, almost mucoid, was exposed and sucked out from the left frontal lobe.

Sections showed that the tumor was a spongioblastoma multiforme.

The patient was discharged improved, but he returned for roentgen treatment; he was able to work and was free from symptoms until March 1929, when he had convulsions and evidently a recurrence.

On April 3, 1929, at a second operation, a large recurrence was found; it weighed 45 Gm. It was removed as completely as possible.

The patient was discharged on April 15, 1929; he was temporarily improved but died on December 8.

Roentgen Treatment.—The first roentgen treatment to the tumor bed was given in January 1927. A single course was administered at that date, and three additional courses were given at intervals of six weeks. The tumor bed may therefore be said to have received approximately 4 threshold erythema doses over a period of about eighteen weeks.

Case 12.—H. H. W., a man aged 24, who was referred by Dr. E. R. Denny, of Tulsa, Okla., was admitted to the Barnes Hospital on Jan. 10, 1930, complaining of blurring of vision, headache and vomiting. Two months before admission he began to have headache; this increased in severity and was accompanied by vomiting. One month later he noticed numbness of the left hand; he would drop objects put into the left hand. Two weeks before admission he noticed numbness of the left leg.

Examination revealed a high grade of bilateral choked disk; disturbance in the left hand, which was more a disturbance of cortical sensation than a true astereognosis; facial weakness and Oppenheim and Babinski signs on the left side. A ventriculogram confirmed the idea that the patient had a lesion of the right side.

On Jan. 17, 1930, a cerebral craniotomy was begun, with the area under local anesthesia, but the patient became so unmanageable that general anesthesia became necessary. This increased the intracranial pressure to such an extent that operation was much more difficult. As not enough fluid could be obtained from the ventricle to reduce the pressure the dura had to be opened rapidly, and the tumor began to rupture. The tumor was removed, the greater part being removed by suction. This was thought to have been done with fair thoroughness. The tumor was the size of an orange.

The tumor was a spongioblastoma multiforme.

The patient had an uneventful recovery and was discharged from the hospital on Feb. 7, 1930. Roentgen therapy was given, and he returned to work and was well until March 1931, when he began to notice weakness of the left arm and leg. The decompression began to bulge, and he was readmitted and again operated on.

On April 17, 1931, a huge recurrence was removed, as at the previous operation, by suction. One part of the tumor seemed to have invaded the ventricle, and this portion was excised with the electric knife. The tumor weighed 24 Gm.

The patient returned home again somewhat improved but died in October 1931.

Roentgen Treatment.—The patient received a single course of roentgen treatment in February 1930. The tumor bed received approximately 1 threshold erythema dose over the two days required for delivering the radiation.

OTHER GLIOMAS

We have seen improvement in symptoms following roentgen treatment occasionally in cases of other types of glioma, but as these are types that grow slowly, we do not consider that the cases exhibit as convincing evidence of the effect of roentgen radiation. In 1 case of spongioblastoma polare (case 13) the patient has now been living eighty-two months, over six years. During that time she has been operated on twice for the removal of the tumor, the last time being in 1932.

CASE 13.—L. G., a girl aged 2½ years, who was referred by Dr. V. Satterfield and Dr. Fred Jostes, of St. Louis, was admitted to the Children's Hospital on Aug. 20, 1928. Six months before the child's right eye turned in, and she tended to hold her head to the right shoulder. Two months before admission she complained of headache and vomited. Two weeks before admission she began to stagger and fell definitely to the right and backward. Vision was impaired but not gone. The parents refused to permit an operation.

The child was brought back on Sept. 14, 1928, totally blind. In the meantime she had had a convulsion, and walking had become much worse. Roentgenograms showed marked signs of pressure in the skull, with separation of the sutures. There were ankle clonus and a Babinski sign bilaterally; paralysis of the sixth nerve on the right side, and normal eyegrounds. The diagnosis was cerebellar tumor.

On Sept. 17, 1928, a cerebellar craniotomy was performed, and a hard tumor was exposed near the midline. Because of the patient's condition removal was postponed. One month later the wound was reopened and a tumor removed from the fourth ventricle; it extended up into the aqueduct of Sylvius. There was some difficulty with wound healing, and the patient had a cerebrospinal fistula. This healed after a few weeks. She was discharged on Dec. 12, 1928.

The diagnosis was spongioblastoma unipolare.

Roentgen treatment was given before the patient left the hospital and has been given at frequent intervals since.

The patient was readmitted on Feb. 22, 1932. The cerebellar wound was beginning to herniate markedly and was tense; the patient had begun to complain of some headache. Roentgenograms showed a definite calcified mass.

On Feb. 23, 1932, a tumor, which was dumb-bell shaped, was partly removed, and a free flow of cerebrospinal fluid was obtained from the iter, but some of the tumor which was attached to the floor of the fourth ventricle could not be removed because every time it was raised there was interference with the child's respiration. The tumor weighed 12 Gm.

Thus far the child has shown no further symptoms.

Roentgen Treatment.—In December 1928 one course of roentgen treatment was given. This was repeated six weeks later. No further radiation was given until March 1932, when another course was administered. Two more courses were given at intervals of six weeks. The tumor bed may be said, therefore, to have received 2 threshold erythema doses in 1928 and 3 threshold erythema doses over a period of twelve weeks in 1932.

In a group of 8 cases of oligodendroglioma striking improvement after roentgen treatment occurred in 1 case (case 14).

CASE 14.—H. H. S., a professor of mathematics, aged 42, who was referred by Dr. S. I. Schwab of St. Louis, and Dr. R. M. Crews of Fulton, Mo., was admitted to the Barnes Hospital on June 30, 1930. For nine years he had had convulsions occasionally. About five months before admission he began to complain of intense headaches and disturbance in vision.

The positive findings were: slight prominence of bone to the right of the median line in the right frontal region; slight haziness of disk margins with tortuosity of the veins and facial weakness, and absence of the ankle jerk on the left side. Roentgenograms showed a calcified tumor in the right frontal region.

On July 2, 1930, a frontoparietal craniotomy on the right side was performed, and a tumor adherent to the dura was removed from the right frontal lobe. The right ventricle was not opened, but the tumor extended down close to it. The tumor weighed 75 Gm. The growth was an oligodendroglioma.

The patient made an uneventful recovery and was discharged on July 16, 1930. He resumed work but after a few months was unable to continue. There was herniation of the decompression, and loss of memory was marked.

On June 5, 1931, an extensive resection of the right frontal lobe was carried out. The ventricle had to be opened, and the tumor tissue had grown into the anterior portion of the thalamus and was removed. A huge defect was left. The tumor weighed 60 Gm. The patient made an uneventful recovery and was discharged on June 17, 1931.

Six months later he was readmitted because of marked mental confusion. Though there was no herniation, it seemed likely that the tumor was beginning to cause symptoms, and a further operation was recommended. The patient's brother, a physician, refused and requested that roentgen treatment be tried. The result was surprising. Memory improved, the patient was able to resume work, was bright, answered questions intelligently and stated that every time he received roentgen treatment he felt distinctly better.

A year after he had received roentgen treatment he was not able to work, but he discussed mathematical problems at the time when he came to the hospital for treatment. He had received so much roentgen radiation that Dr. Moore hesitated to give any more. The last treatment was given on July 21, 1933. The patient was seen on Dec. 28, 1933. At that time he showed marked mental changes, slept much and evidently had another recurrence. He died in July 1934.

Roentgen Treatment.—The first course of roentgen treatment directed at the tumor bed was administered in February 1932. A total of six courses were given, each at intervals of six weeks. The tumor bed may therefore be said to have received approximately 6 threshold erythema doses over a period of thirty weeks. Eleven months after the last mentioned treatment a single course was repeated, and still another course was given five months later.

GENERAL COMMENT AND CONCLUSIONS

These observations have led us to the decision that in future we must give even more therapy than we have given before. The tendency among roentgenologists in the last years has been to give more intensive therapy; certainly that has been the attitude that Dr. Moore has taken. This seems the logical conclusion resulting from this study.

There are several ways by which the dose administered to the tumor bed may be increased. If multiple ports are employed and the beams are directed so as to converge at the region from which the tumor has been removed, the total dose reaching the tumor bed may be considerably greater than that delivered to any single field. If the areas of skin employed are small it may be necessary to use a large number of ports because of the loss in percentage depth dose with decrease in size of the irradiated area. The percentage depth dose obtained from any particular beam may be raised if the target-skin distance is increased or a heavier filter is employed (Failla and Quimby[12]). There is a decided trend toward the use of fractionated doses in the treatment of tumors in other parts of the body. It seems logical to assume that such a method might be suitable in cases of intracranial neoplasm. By this means a greater total dose can be delivered to the skin and site of the tumor but administered over a longer period of time. Necessarily, a greater total dose must be employed to produce the same biologic reaction that would result from a lesser dose delivered over a shorter time. If the tumor recuperates from each exposure less rapidly than other portions of the brain, then the effect in the tumor bed will become greater than that in the rest of the cranial contents.

This study has led us to the following conclusion in regard to the use of roentgen therapy in cases of tumor of the brain: Larger doses of roentgen radiation should be used in the treatment of tumors of the brain. This can be accomplished by one of four methods; namely, (1) by using multiple portals, instead of two or three as we have done in the past (in that way it will be possible to deliver a greater total dose to the tumor bed); (2) by employing fractionated exposures over a prolonged time; (3) by raising the percentage depth dose either by increasing the target-skin distance or by using heavier filters or by a combination of both methods; (4) by devising a safe method of giving therapy into an open cranial wound, thus avoiding the danger to the scalp and bone flap and delivering a much larger quantity of roentgen radiation into the tumor bed.

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DISCUSSION

DR. GILBERT HORRAX, Boston: I do not know whether I can add anything to what Dr. Sachs has said regarding roentgen treatment, but I do want to say that I think his contribution is vital. I believe that all physicians who deal with this problem realize that they are not at all sure what can be accomplished with roentgen therapy. There are certain types of tumors which are known to be definitely affected by it; others are believed not to be affected in any way. I agree with Dr. Sachs that administration of much larger doses of roentgen radiation through many portals and, if possible, as he said, through an open cranial wound may solve the problem, at least for the present, until a better and different kind of apparatus is available for giving a larger dose of roentgen radiation without damaging cutaneous areas.

I believe that in cases of medulloblastoma one does not need to perform a radical extirpation of the tumor before administering roentgen therapy. When an adequate cerebellar decompression is performed the pressure is taken off the vital areas, so that if the tumor swells, as it doubtless does, no compression symptoms due to the swelling occur. I believe that, of course, one must take out a piece for identification, but if more than that is done it is at least theoretically easier for implantations of medulloblastoma to occur along the cerebrospinal axis. It is, of course, as Dr. Sachs no doubt would have brought out had he had time to continue his paper, of great importance to irradiate the whole cerebrospinal axis in cases of medulloblastoma because of the danger of implantation.

DR. ERNEST SACHS, St. Louis: It seems to me that the danger from implantation arises from opening the subarachnoid space, and therefore the danger is just as great when a specimen is taken out as when a radical extirpation is performed. I did not have time to discuss one phase particularly, the question of the spongioblastoma multiforme, the glioblastoma which, I think, has caused the greatest concern. In the last few months my colleagues and I have tried something new. I merely mention it in the hope that other surgeons will try the same thing. We are following up our cases, sending for patients with glioblastomas when they show the first evidence of possible recurrence. We perform a second radical extirpation and then implant radium all around the wall of the tumor bed in the hope that in this way a glioblastoma may finally be eradicated, a thing which, at least in our clinic, has never been accomplished.

Case Reports

POLYNEURITIS ASSOCIATED WITH ETHER ANESTHESIA OCCURRING IN THREE MEMBERS OF ONE FAMILY

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Polyneuritis of obscure origin always presents interesting problems. The observations of Wechsler,[1] Minot, Strauss and Cobb [2] and others on vitamin deficiency, especially deficiency of vitamin B_1, as the causative factor have clarified many cases not only from an etiologic but also from a therapeutic standpoint. This theory has been substantiated in a recent study by Jolliffe and Joffe [3] on twenty-four alcoholic addicts. They employed Cowgill's [4] equation for predicting the vitamin B requirement (referred to as the "Vit/Cal ratio") and found that alcoholic persons having an adequate "Vit/Cal ratio" in the diet did not present neurologic changes even when the consumption of alcohol was continued over a prolonged period. However, alcoholic addicts in whom neuritis developed had an inadequate intake of vitamins, according to the formula, for at least twenty-two days.

Collier [5] reported a series of cases of polyneuritis of unknown etiology and stated that marked changes in the spinal fluid occurred in these cases. In those in which the condition was associated with an early ophthalmoplegia there was frequently a deep yellow-brownish fluid. In some cases with a subacute or chronic course there was often a moderate or high pleocytosis and an excess of protein. Cases in which there were marked reactions of the spinal fluid offered a more favorable prognosis. In this series Collier reported two cases of the Landry type, with recovery. These pathologic changes in the spinal fluid are suggestive of marked involvement of the nervous system, both central and

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5. Collier, James: Peripheral Neuritis (Morison Lectures), Edinburgh M. J. **39**:601, 672 and 697, 1932.

peripheral, and are indicative of a definite defense reaction. He expressed the opinion that the ultimate etiologic factor may prove to be some obscure virus disease, particularly in the epidemic form of polyneuritis.

In our three cases no definite etiologic factor could be determined. Careful studies of the family history did not reveal any evidence of familial or hereditary tendencies. In each case the patient had a simple surgical procedure, without suppuration, for pain in the lower part of the abdomen, under ether anesthesia. Within from ten to fourteen days definite symptoms of polyneuritis manifested themselves. The progress of the disease was more rapid than that usually encountered in this condition, and the onset of the paralysis was more sudden. The course of the disease was similar in all three cases. These points suggest a probable common etiologic factor and a toxic origin, although the interval between the first and the third case was over four years. It is striking, as a coincidence at least, that the polyneuritis had its onset in each case shortly after the administration of ether anesthesia.

REPORT OF CASES

CASE 1.—The patient was a sister of our patient and the oldest sibling. The family history was essentially irrelevant, except that the mother and one brother were highly neurotic. The father, two brothers and one sister were living and had always been well.

When the patient was 16, she underwent tonsillectomy under chloroform anesthesia, with normal convalescence; at the ages of 21 and 23 she had pregnancies with normal delivery under chloroform anesthesia, without any sequelae.

At the age of 28, in January 1930, she had severe pain in the right lower abdominal quadrant, with nausea but no emesis. Laparotomy was performed with the patient under ether anesthesia two days later because of the persistence of pain and nausea. No definite pathologic change was found except a slightly inflamed appendix, which was removed. She had an uneventful convalescence and was discharged from the hospital on the eighth day. The intake of food was normal. On the tenth postoperative day there developed burning sensations in both feet, which increased to severe pain in twenty-four hours. On the following day the pain became generalized, involving all four extremities. The next day she noticed weakness in both arms, and within three days she was unable to stand up because of impaired strength in both lower extremities. A few days later there developed difficulty in swallowing solid food, but she continued to take liquids fairly well. The weakness in all four extremities became more pronounced, and within one week complete paralysis developed, so that she was unable to move her arms or legs. Associated with this was marked hyperesthesia, and she could not endure even the weight of the bed sheet. The voice became weaker, and she could not talk above a whisper. About two months after the onset of the neuritis some atrophy of the muscles of the extremities was noted. This gradually became so marked that "all the muscles seemed to have wasted away." About that time the pain subsided, but the hyperesthesia continued. There were burning pains in both eyes, with gradual loss of vision. This continued for about six weeks, with a slow return to normal. There was also some impairment of control over the bladder and rectum for about three weeks. At times the sensorium was somewhat clouded. After the fourth month definite but slow improvement was noted. During the early part of July there was a gradual return of motion in all four extremities, more marked in the legs. This continued, and by November she

had sufficiently recovered to be up and about and to assist a little in housework. About January 1931, within one year after the onset of the neuritis, recovery was complete. She stated that during the greater part of the illness all reflexes were absent. We were unable to obtain a report of laboratory findings, but she stated that her physician had informed her that her blood, spinal fluid and urine were normal. In May 1932 she had an uneventful parturition, having passed through a normal pregnancy. She refused to take an anesthetic at that time because of the previous experience. She was examined by one of us (E. M. H.) on Feb. 8, 1935. General physical and neurologic examinations gave normal results throughout, and she said that she was perfectly well.

Case 2.—The patient was a man, brother of our patient, and was the fifth child in the family. The history was obtained from his sister (case 1), who was with him during his last illness. The personal history was unimportant, except that at the age of 19 he underwent a tonsillectomy under chloroform anesthesia, with uneventful recovery. At the age of 22, in April 1933, he injured his back while wrestling and complained of severe lumbosacral pain. Four days later the pain became localized in the right lower abdominal quadrant. Appendectomy was performed with the patient under ether anesthesia. A fairly normal appendix was removed, and the convalescence was uneventful. After the third postoperative day he was able to take both liquid and solid food in normal quantities. During the period of hospitalization his pulse rate and temperature had been normal. He was discharged on the thirteenth postoperative day. On the following day there developed burning pains in both lower extremities, which gradually became generalized and were very severe within two days. He became extremely restless but was able to be up and to walk about in his home. Within one week there developed marked weakness of both the upper and the lower extremities. He complained of poor vision and gradually became blind; this state continued for about two weeks, with a slow return to normal. About that time he became delirious and had several convulsions during two days. His condition gradually improved, and the confusion subsided. The weakness in the extremities became more pronounced, but he was able to move his arms and legs somewhat. The pain in the extremities continued, but there was some return of motor function. About that time there developed an ischiorectal abscess, which was lanced and drained. A few days later he complained of sudden severe pain in the right side of the chest and died a few minutes later, two months after the appendectomy. The attending physician stated that death was due to a pulmonary embolus. We were unable to obtain a report of temperature, pulse, neurologic examination or laboratory findings during the illness. However, the history is suggestive of polyneuritis.

Case 3.—Our patient, a woman aged 27, the third child in the family, was referred to one of us (E. M. H.) by Dr. W. F. Cantwell, of International Falls, Minn., and was admitted to the Mounds Park Sanitarium on Dec. 15, 1934. Her personal history was unimportant. During the spring of 1934, while she was in a nurses' training school, she had an occasional attack of pain in the left lower abdominal quadrant. This continued for several days but was not sufficiently pronounced that she had to discontinue her nursing duties. She married in June 1934 and continued to have an occasional attack of pain in the left lower abdominal quadrant. On October 25, during a menstrual period, she had a similar attack of marked severity, accompanied by nausea and vomiting. This persisted for three days and necessitated the hypodermic administration of morphine for relief. The condition did not improve, and four days later laparotomy was performed under ether anesthesia. A normal, elongated appendix and a cystic left ovary were

removed. The uterus was somewhat enlarged by a two months' pregnancy. There was no infection of the wound, but it healed poorly. The postoperative course was satisfactory, and on the third day she was able to take solid food. On the following day the severe abdominal cramps returned, accompanied by emesis. She did not respond to the ordinary treatment or to hypodermoclysis. On the tenth postoperative day, under ether anesthesia, the uterus was curetted. A few days prior to the first operation she complained of slight pain in the region of the right shoulder. The day after the curettement the pain in the right shoulder became more severe and radiated down the right arm. On the following day a similar condition developed in the left arm, and within a few days the pains became generalized throughout the body and extremities, with some return of the abdominal pain. The stitches were removed at the usual time, but the wound began to bleed and had to be resutured. The condition improved slightly; appetite returned, and the pains were less pronounced. In about two weeks she began to feel nervous, shaky and irritable. She lost appetite, and her weight decreased. About that time the pains in the lower extremities became very severe, accompanied by marked burning sensations in the feet. Two days later she noticed weakness in both legs, which progressed to almost complete paralysis in twenty-four hours. On the following day the arms grew weak, and within a day or two they were "quite helpless." The pain in the extremities became excruciating and required the hypodermic administration of morphine for relief. Hoarseness and marked photophobia developed. There was difficulty in swallowing, but she was able to take a fair amount of liquid food.

Physical examination on December 15 (six weeks after the operation) revealed a fairly well nourished woman, moaning constantly with pain. The arms and legs were held in moderate flexion. The recent abdominal wound was practically healed. No physical abnormalities were noted. The outline of the heart and heart sounds were normal. The pulse rate was 140. The blood pressure was 138 systolic and 90 diastolic. The nutrition of the skin was fair, but there was mottling at the distal parts of the extremities.

Neurologic examination revealed moderately dilated pupils with normal response to light and in accommodation; normal fundi, normal eye movements, no nystagmus, normal movements of the face and tongue and a voice which was audible and somewhat above a whisper. At times the patient cried out in a loud voice. The swallowing of liquids was normal.

There was generalized motor weakness, more pronounced in the upper extremities. Both arms were completely paralyzed, except for slight movements at the shoulder girdle and of the fingers. She was able to execute all movements with the lower extremities to a limited degree, the impairment of movement of the distal portions being more pronounced. There was slight atrophy of the muscles of the quadriceps group and a suggestion of edema around the feet and ankles. No definite tenderness of nerve trunks was noted, but there was diffuse soreness of the muscles on pressure and marked hyperesthesia to gentle rubbing of all four extremities. Touch, pain, temperature, position and vibration sense were normal throughout, with some indefinite impairment of touch and pain sense in the hands and feet. The biceps and triceps reflexes were absent; the radial reflexes were present but decreased. Both knee and ankle jerks were diminished; there was no clonus of the ankle or Babinski sign. The abdominal reflexes were normal. The control of the sphincters was normal. The sensorium was normal, except for a slight confusion at times.

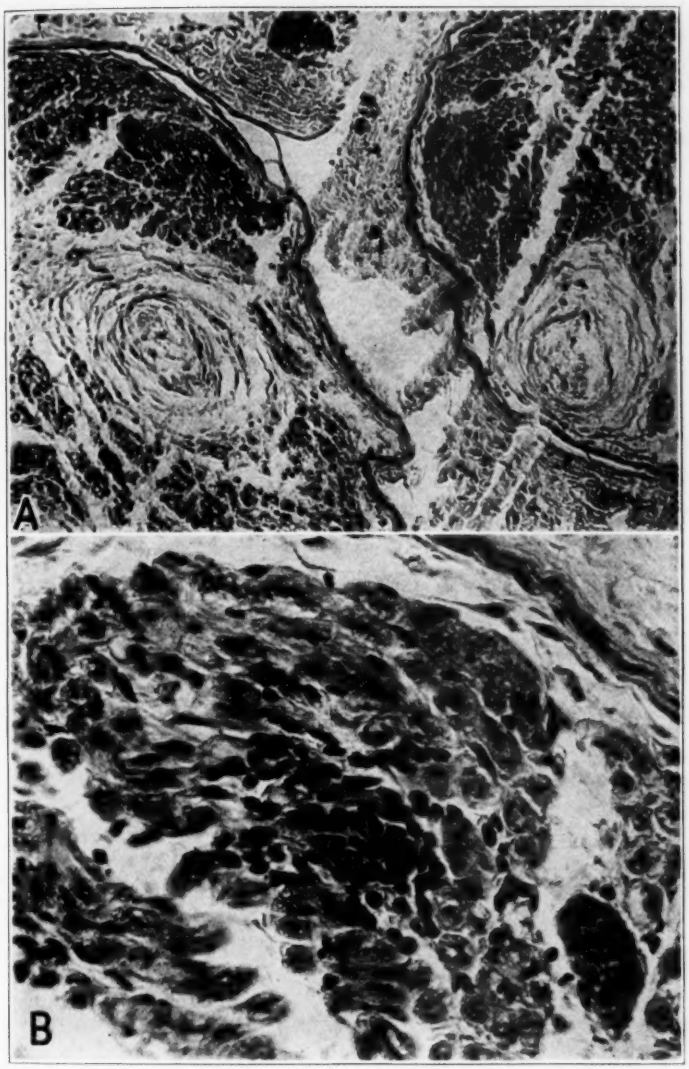

Fig. 1.—*A*, cross-section of fasciculi of the brachial plexus, showing sector fibrosis without any myelin sheath fibers. Hematoxylin and eosin stain. *B*, part of the field shown in *A*, more highly magnified and showing nests of cells in a fasciculus, possibly representing proliferation of neurilemma cells.

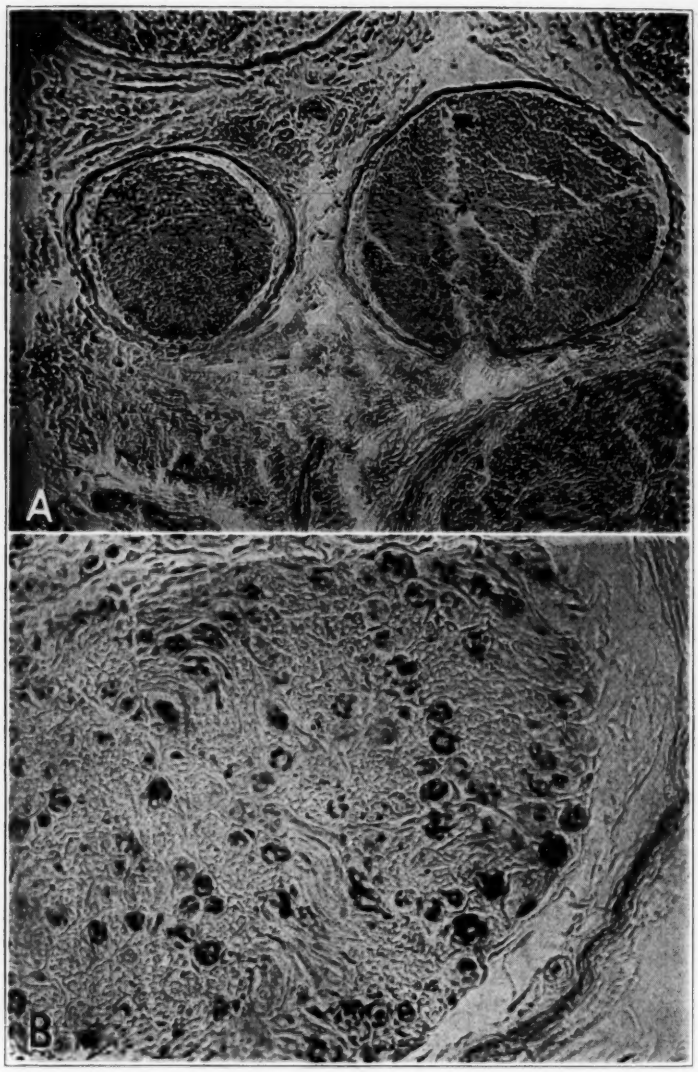

Fig. 2.—*A*, cross-section of fasciculi of the brachial plexus, showing marked loss of myelin sheath fibers. Weigert's myelin sheath stain. *B*, an area from a fasciculus shown in *A*, highly magnified to show the tremendous loss of myelin sheath fibers.

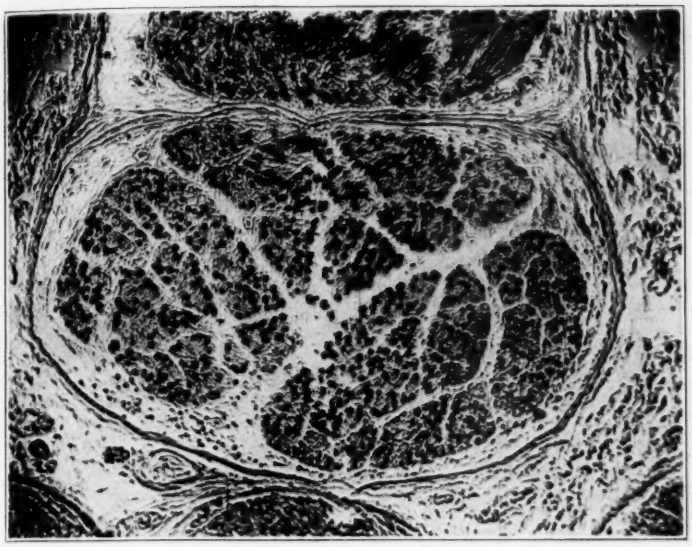

Fig. 3.—Cross-section of the least pathologic fasciculus of the brachial plexus, showing retention of about half the fibers. Weigert's myelin sheath stain.

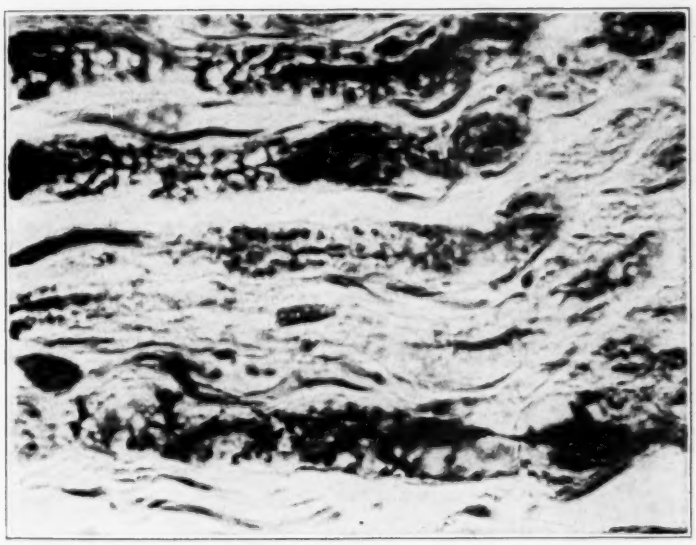

Fig. 4.—Longitudinal section of myelin sheath fibers in the brachial plexus, highly magnified to show marked disintegration of the myelin sheaths. Weigert's myelin sheath stain.

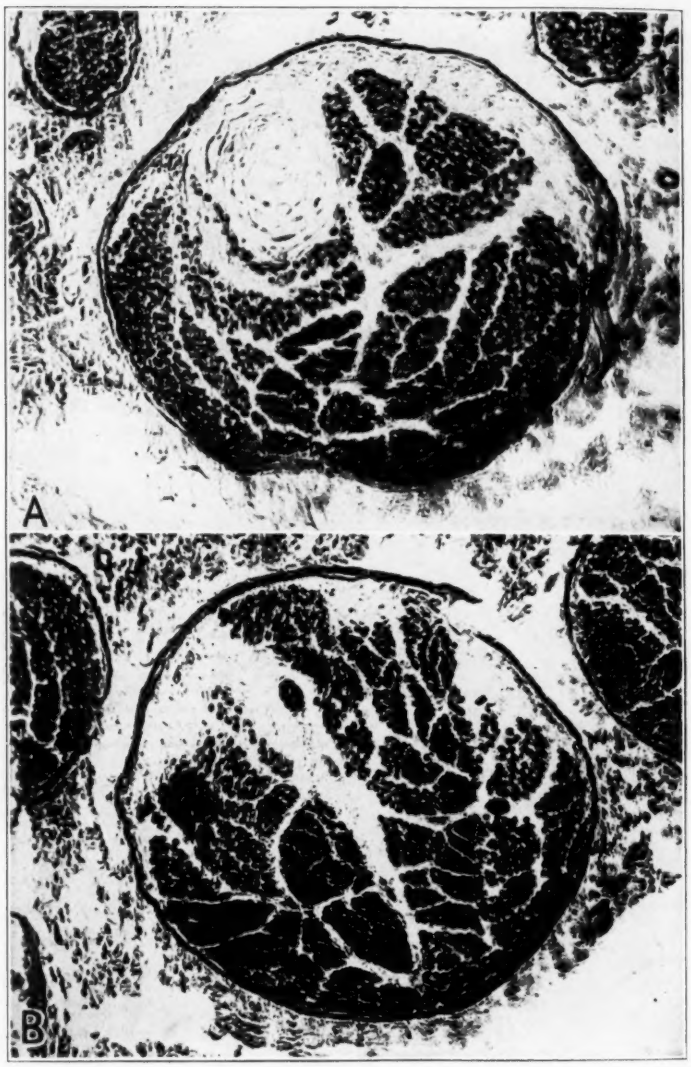

Fig. 5.—*A*, cross-section of the sciatic nerve, showing sector fibrosis with some loss of myelin sheaths. Weigert's myelin sheath stain. *B*, cross-section of the sciatic nerve, showing diffuse fibrosis with loss of myelin sheaths. Weigert's myelin sheath stain.

Laboratory tests gave the following results: The urine was normal except for a trace of albumin. The hemoglobin concentration of the blood was 80 per cent; the red cell count, 4,480,000, and the white cell count, 9,100, with a normal differential count. The Wassermann and Kahn reactions of the blood were negative. The spinal fluid was clear, with a pressure of 8 mm. of mercury, no evidence of block, 2 cells, a trace of globulin, negative Wassermann and Kahn reactions, a colloidal gold curve of 1111100000 and 42 mg. protein per hundred cubic centimeters. No analysis of the gastric contents was made.

While in the hospital the patient was given large quantities of liquid food, brewers' yeast and sedatives. Daily hypodermic injections of morphine or dilaudid were necessary for the severe pain and to produce sleep. The temperature was normal throughout the period; the pulse rate varied between 112 and 152 but was around 140 most of the time. During the second week there was a slight improvement, in that the patient stated that the pain was not quite as severe, and her general tone appeared better. She died suddenly, however, on Dec. 29, 1934, evidently as a result of involvement of the vagus nerve. Death occurred on the fifty-ninth postoperative day.

Postmortem examination was made eight hours after death. The body was fairly well nourished, with some atrophy of the muscles of the upper and lower extremities. Nothing abnormal was noted except edema of the lower lobes of both lungs and a cystic right ovary. The brain appeared normal. The hypophysis was somewhat enlarged. The upper part of the cervical region of the spinal cord appeared normal. Sections of the branches of the brachial plexus and of the sciatic nerve were removed and on macroscopic examination appeared normal.

Microscopic Examination of the Nervous System.—Sections were prepared from various parts of the cerebral and cerebellar cortex, the basal ganglia, the midbrain and the medulla. Staining with hematoxylin and eosin, thionine and Weigert's myelin sheath stain revealed no histologic abnormalities in these regions.

The hypophysis was normal except that a small nest of cells was present in the anterior lobe, arranged in irregular columns and well circumscribed from the rest of the lobe. The cells were small, with relatively large nuclei, and the cytoplasm stained purplish with hematoxylin and eosin. Owing to the small size of the mass, no sections were available for special staining to demonstrate with finality the type of the cells. Our impression was that it was a small basophilic adenoma.

Sections from the upper segments of the cervical portion of the cord revealed no pathologic changes. The remainder of the spinal cord could not be studied (permission for its removal could not be obtained from the family).

Sections of the brachial plexus stained with hematoxylin and eosin revealed an occasional fasciculus in which a sector was made up of loose connective tissue with few cells of the connective tissue type and without any myelin fibers (fig. 1*A*). Less common than these areas of fibrosis were small nests of fairly closely approximately mononuclear cells intermingled with the remaining myelin sheaths, possibly representing a proliferation of the neurilemma cells (fig. 1*B*). In some fasciculi the connective tissue had separated small groups of myelin sheath fibers, so that the fasciculus seemed irregularly sclerotic. In the longitudinal section these fibrotic patches could be traced throughout considerable distances.

In sections of the brachial plexus stained by the Weigert method many of the fasciculi showed a tremendous loss of fibers (fig. 2). A few showed retention of possibly half their fibers, but even in these the myelin sheaths were badly fragmented and swollen (fig. 3). Longitudinal sections from the brachial plexus confirmed the impression of marked destruction of myelin sheaths (fig. 4). The

axis-cylinders were practically not demonstrable with the Bielschowsky stain in the sections from the brachial plexus.

The topography of the sciatic nerve was much more normal than that of the brachial plexus, though there, too, the connective tissue of the endoneurium had undoubtedly undergone some proliferation. The sector fibrosis of the sciatic fasciculi was much less frequent, though present (fig. 5). Sections stained by the Weigert method showed preservation of most of the fibers of the myelin sheaths, though there was undoubtedly some loss of fibers. Longitudinal sections showed occasional fragmented, irregular or ballooned sheaths (fig. 6).

Pathologically the picture was one of profound demyelinization in the brachial plexus, with a similar but much milder process in the sciatic nerve. The picture was one of combined disintegration of fibers with overgrowth of connective tissue.

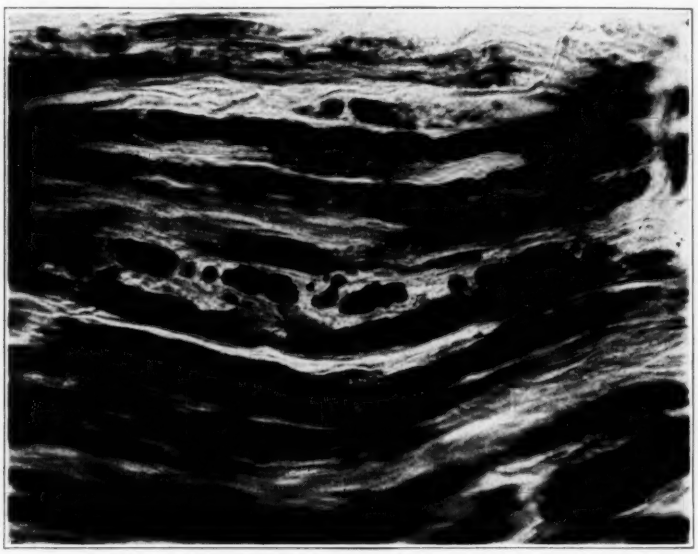

Fig. 6.—Longitudinal section of the sciatic nerve under high power magnification, showing degenerating myelin sheaths. Weigert's myelin sheath stain.

COMMENT

A review of the literature did not disclose any cases of polyneuritis occurring in one family similar to our group. The only familial cases reported were those in which there was a known etiologic factor and which occurred simultaneously. Among these were cases in members of the same family poisoned with arsenic or some other chemical or with infections, in whom acute symptoms, gastro-intestinal or otherwise, manifested themselves immediately with the onset of the disease. Later, polyneuritis developed.

No reference to ether as an etiologic factor in polyneuritis was found in the literature except in Grinker's [6] textbook. Among the list of

6. Grinker, R. R.: Neurology, Springfield, Ill., Charles C. Thomas, Publisher, 1934, p. 24.

carbon compounds he mentioned ether, without any further detailed description in the text. The mononeuritis produced by the injection of ether directly into a nerve trunk is well known and readily recognized. Extensive studies have been made on workers exposed to the fumes of ether or of ether and alcohol over a prolonged period in the course of occupation, particularly those employed in the manufacture of smokeless powder and artificial silk. In the cases of acute poisoning the usual symptoms encountered were those of the well known "ether jag." In the cases of chronic poisoning Hamilton [7] stated that the most frequent complaints were anorexia, obstinate constipation, cardiac palpitation, nephritis, numbness of the fingers and burning sensations in the feet. The latter two symptoms might be suggestive of mild polyneuritis. However, there were no further manifestations, and the numbness and burning subsided soon after a change of environment.

In a series of studies of the blood Minot [8] noted marked polycythemia in 76 per cent of the workers. The red cell count varied between 5,500,000 and 7,800,000, while the white cell count was practically normal.

Among neuropsychiatric disturbances, Hayhurst [9] reported one case of a patient with acute mania who died in uremic convulsions. In his report he stated that the medical literature reveals a case of chronic ether poisoning characterized by a Korsakoff syndrome, but he gave no reference.

Most of the patients made a rapid recovery after they were removed from their hazardous occupations. Postmortem observations were not given in detail. However, the interesting observation was made that the cerebral ventricles retain ether longer than any other portion of the body.

Because chloroform has a somewhat similar chemical formula to that of ether, the case of neuritis due to chloroform reported by Raymond and Cottenot [10] is of interest. After a suicidal attempt with chloroform, the patient had bilateral brachial neuritis. One cannot, however, exclude the possibility that the neuritis was a pressure syndrome occurring during the chloroform stupor and was of the traumatic type.

SUMMARY

Three cases of polyneuritis in one family, the condition in each instance developing within two weeks after a simple laparotomy performed with the patient under ether anesthesia, are reported. In all three cases there was a rather acute onset, with rapid development of the motor paralysis, and a fairly similar course.

7. Hamilton, A.: Industrial Poisons in the United States, New York, The Macmillan Company, 1925.

8. Minot, G. R., and Hamilton, A.: Ether Poisoning in the Manufacture of Smokeless Powder, J. Indust. Hyg. **2**:41 (June) 1920.

9. Hayhurst, E. K., in Occupation and Health: Encyclopedia of Hygiene, Pathology and Social Welfare, International Labour office, Boston, World Peace Foundation, 1930.

10. Raymond and Cottenot: Progrès. méd., 1908, p. 341; quoted in Lewandowsky, M.: Handbuch der Neurologie, Berlin, Julius Springer, 1910, vol. 2, p. 122.

It could not be determined whether ether was the etiologic factor because of an idiosyncrasy for this drug or whether the onset of the condition immediately after the administration of the anesthetic was merely a coincidence.

Neuropathologic studies in one case revealed extensive demyelinization with overgrowth of connective tissue of the peripheral nerves.

1125 Lowry Medical Arts Building.

DISCUSSION

DR. FREDERICK P. MOERSCH, Rochester, Minn.: I have been much interested in these cases of Dr. Hammes, especially from the pathologic standpoint. He showed several sections with areas of fibrosis in the nerves. Yesterday, in presenting cases of polyneuritis, I purposely avoided showing similar sections because I did not know the exact significance of the fibrosis. Several years ago Dr. Kernohan and Dr. Woltman found areas of fibrosis in cases of diabetic neuritis and later in cases of arteriosclerotic neuritis. I believe that it is Dr. Kernohan's impression that the fibrosis is secondary to a vascular change, probably thrombotic. Therefore the areas of fibrosis may be independent of the other changes that Dr. Hammes presented. If that is true, his sections are essentially like those I showed yesterday, except that in his cases there was what appears to be a definite etiologic factor, namely, ether, while in my cases, I believe, the condition probably was caused by an infection or a virus.

DR. B. SACHS, New York: Had the ether been properly examined? Was the same kind of ether used?

DR. ERNEST M. HAMMES: These three cases occurred during a period of over four years. I do not know anything about the ether used. However, the patients were operated on in three different hospitals, with long intervals between operations, and for that reason I feel certain that a different sample of ether was used in each case.

Clinical Notes

XANTHOMATOSIS AND THE CENTRAL NERVOUS SYSTEM (SCHÜLLER-CHRISTIAN SYNDROME)

CHARLES DAVISON, M.D., NEW YORK

In a previous communication entitled "Xanthomatosis and the Central Nervous System"[1] I described numerous demyelinated plaques filled with compound granular corpuscles and giant glia cells in the white matter of the central nervous system. Typical foam cells, as noted in other organs, were not observed in the nervous system at that time. Because of this I was of the opinion that the two types of cells (compound granular corpuscles and giant glia cells) were analogous to the foam cells and the reactive type of cells demonstrated in other organs. Since then Chiari,[2] in studying the nervous system in a case of xanthomatosis, found the typical foam cells. Stimulated by his observations, I studied further sections of the brain and succeeded in finding occasional collections of foam cells (fig. 1 *A, B* and *C*) within the demyelinated plaques. The original idea that the giant glia cells are reactive in type and are analogous to the fibrosis in other organs still holds true. The compound granular corpuscles are the transformed microglia cells acting as phagocytes in the breaking down of nerve tissue, while the foam cells are part of the generalized disturbance in the cholesterol lipoid metabolism.

1. Davison, Charles: Xanthomatosis and the Central Nervous System (Schüller-Christian Syndrome), Arch. Neurol. & Psychiat. **30**:75 (July) 1933.

2. Chiari, H.: Ueber Veränderungen im Zentralnervensystem bei generalisierter Xanthomatose vom Typus Schüller-Christian, Virchows Arch. f. path. Anat. **288**:527, 1933.

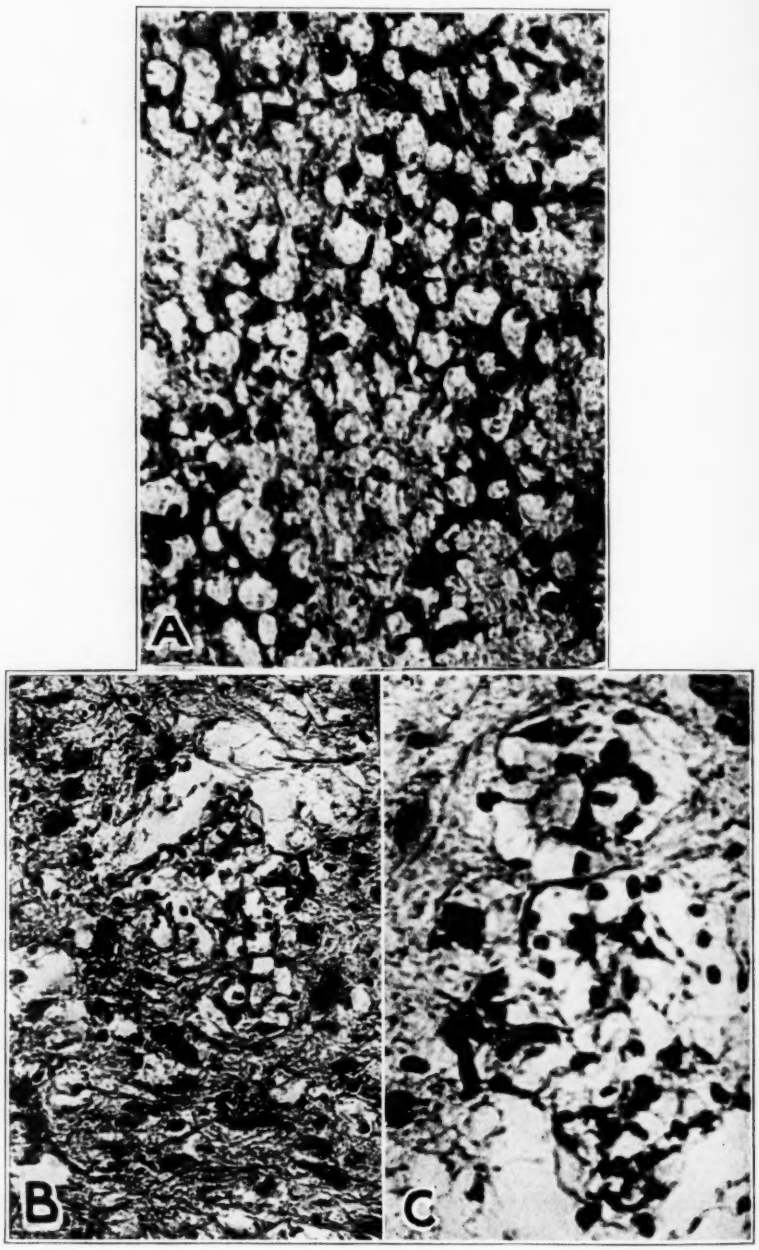

Fig. 1.—*A*, collection of foam cells in the white matter of the cerebral hemisphere (cresyl violet stain; × 200). *B*, small collection of foam cells in the white matter (hematoxylin and eosin stain; × 200). Notice the giant glia cells at the periphery. *C*, same as figure 1 *B* (× 400).

SPECIAL ARTICLES

PSYCHOLOGY IN MEDICAL EDUCATION

F. L. WELLS, PH.D.
BOSTON

The remarks I have to offer will center about objectives—what psychology in the medical curriculum can be expected to do. Two things should be expected of it before all others: It should give the student knowledge about the psychologic technics at his disposal in dealing with his professional problems. Further, it should give him that orientation of personality toward his profession which will cause him to treat, not diseases merely, but sick persons.

Although the best college teaching of psychology has moved far in the direction of the goal from where it was in my undergraduate days, it still seems fair to assume that in these respects the students even in the most exacting medical schools are starting from scratch. However, given the cultural background and above all the level of intelligence, quantitatively seldom below the upper 5 per cent, which characterizes medical students in first class schools, the clinical application of psychology would probably prove to be among the more readily assimilable portions of the medical curriculum. In the first place, the more objective means of gaging the mental equipment of a subject should be presented to medical students, an intelligent opinion of the uses to which they may be put and how far they are to be trusted. From its sources in applied psychology, psychometrics has reached a reasonably well understood place in the study of the psychoses and mental deficiency, that is, the problems that come specially to the attention of the psychiatrist. In the rest of medicine, knowledge of it is but little diffused; yet it appears that the physician with no psychiatric specialization frequently encounters situations in which the quantitations of mental life are no less relevant. The well trained physician should recognize such situations when they occur and know where to look for guidance. That is not a lengthy or esoteric matter; so far as it can be put in black and white, two thousand words would be enough for a concise formulation. Its basis is naturally the clinical material that turns up in the setting of the general hospital. Such material brings up psychometric problems substantially the same as those of the psycho-

Based on a round table discussion at the meeting of the American Psychiatric Association, Washington, D. C., May 16, 1935.

pathic clinic, particularly in the outpatient service. Questions of mental level, as applied to adjustment in school, legal responsibility or the process of deterioration, occur in both settings. Perhaps the general hospital is more frequently concerned with problems arising out of injuries to the head, and the distinction between functional and organic symptoms. Without special psychiatric training the physician's understanding of measurement of mental ability in such problems is disproportionately limited.

Thus a man was referred to the psychiatrist from elsewhere in a general hospital as having low mentality; the psychiatrist, skeptical, asked for quantitation. The patient turned out to belong in the upper 10 per cent as regards intelligence. The basis of the original judgment appeared to have been an active participation by the patient in communist affairs. A modicum of technical information would go far to obviate so crude a mixture of clinical judgment with political philosophy.

In another case, that of a young man, the question of deficiency was raised; yet the patient quickly, if brokenly, was telling of a high school course he had had in the history of civilization. Then it became an issue between gross organic disturbance and schizophrenia. The note of psychometric observations reads substantially: "The picture is one of a mild euphoria, with rambling talk, and a reduction of intellectual functions to the neighborhood of a 7 year mental age. Memory and learning functions are profoundly affected, and there is failure to name common objects or naming of them only in terms of use." On that basis probably most psychiatrists would lean to an organic interpretation, as did the attending physicians; serologic examination later disclosed juvenile dementia paralytica. But as concerns the original question of defect, for a rough and ready criterion one does well to watch carefully the language of the patient and note how many "big" words he uses understandingly. His level may be a good deal higher than this; it cannot well be much lower. It is perhaps by an unstudied use of this criterion that experienced social workers sometimes acquire an uncanny ability to predict an intelligence quotient.

It is not intended that the physician concern himself with a knowledge of psychometric technics themselves, beyond what is necessary to understand their purport; but he should well understand what can be expected of them and should know when and how to use them, just as he should know about the use of x-rays. Concretely speaking, medical students in general should go through at least one quantitative procedure, such as an alpha test, see another, such as a Binet test, and have placed in their hands at least some specific information about them. I try to do this in my teaching. Also, psychiatrists, and possibly physicians generally, should know how to use (and when not to use) one or two of the procedures the administration of which is relatively

simple, like Kent's ten minute oral test or the alpha and beta procedures, lately revised. In a way this is more important for the general practitioner, because where there are competent psychiatrists there are likely to be competent psychologists also (in the school systems for example), but the competent general practitioner will be found in the absence of both. The physician who is thus sensitized to individual differences will be a far better adviser in questions of personal adjustment that inevitably come before him.

It seems unwise generally to encourage even the psychiatrist to assume responsibility for any but the simplest psychometric technic. This he can seldom do without sacrificing something more proper to his profession. Unfortunately the motions of a Binet test are so easy to learn, or rather to imitate, that almost any one can derive a figure. But while there is nothing difficult about such tests, they are full of detail that takes overlong to master and are susceptible to satire by any special pleader whose interest lies in that direction. This is what often makes distressing reading of press reports of psychometric examinations in court work. The situation is parallel to that of the self-medicator who died of a misprint.

In addition to such procedures, useful purpose can now be served by other objective and quantitative means that are available. Besides the many and well organized measures of intellectual functions, not a little progress has been made in the less ponderable fields of "personality," associated largely with the names of E. K. Strong, Gordon Allport and Hermann Rorschach. On the other hand, these technics are, even more than Binet tests, fatally easy to administer, and their effective use is difficult; aptitude for their use is perhaps less widely distributed than for the more qualitative and subjective procedures, as outlined by Prout and Ziegler [1] two years ago. Still, almost any one who can properly administer the qualitative procedures can learn to use the quantitative tests, while the reverse is less true. Naturally the aim is to orient the student, not to make records for office files. If, for example, an alpha test is among the technics used in teaching, it must be given individually, and the student must understand every step of the procedure and what it means to him as well as what it means generally. When such a program has been carried out as it should be the student will incidentally have had an efficient course in the psychometrics of the superior person that can easily have technical as well as personal value.

As to the psychology of the profession itself, an almost forgotten cynicism of Bernard Shaw's is that "those who can, do; and those who

1. Prout, C. T., and Ziegler, L. H.: A Study in Psychobiology, Am. J. Psychiat. **13**:1227, 1934.

cannot, teach." The grain of truth that runs through it is responsible for the inquiring eye that mental hygiene from time to time turns on instructors of the young. The root of the matter is that teaching is still among the professions the traditions of which, at least, carry some prestige and status and thereby offer special attractions to any one whose self-feelings stand in need of support. Contrast the teacher with the position of the stereotyped insurance agent, whose institutional kudos is negligible and who depends for his feelings of sufficiency, which need to be ample, wholly on his own personality. The studies of Kerns [2] on personnel at West Point also brought out that the prestige of the military institution makes it attractive to young men with feelings of inadequacy, who seek to compensate them through institutional support. I have noted elsewhere [3] the rôle of similar mechanisms in my own field of clinical and experimental psychology. The outstanding social prestige of all occupations in our culture attaches to the physician. This has received a quantitative demonstration in the studies of Hartmann.[4] It may be of interest that one of Hartmann's hierarchies proved to be, in part, as follows: physician, United States senator, professor, dentist, clergyman, factory manager, nurse, garage mechanic, policeman, barber, cook, fisherman. To generalize, whenever prestige and status are perquisites of "belonging," those who need assurance of status for the support of their ego will seek to belong, and whenever this happens there is the risk that the pupil, the enlisted man or the patient, who is the instrument of this ego-support, will be in a measure—and quite unconsciously—exploited in that interest. The function of psychology in medicine has phases more definite and more facile, but scarcely one more important, than to guard the physician and the patient from this danger to therapy and ethics.

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2. Kerns, H. N.: Cadet Problems, Ment. Hyg. **7**:688, 1923.

3. Wells, F. L.: Evaluation of Personality and Character Tests, Am. J. Orthopsychiat. **2**:327, 1932.

4. Hartmann, G. W.: The Occupational Prestige of Representative Professions in American Society, Psychol. Bull. **31**:695, 1934. The function of a less mature and specially conditioned outlook is represented in a study of high school students (1,622) reported by Nietz (Element. School J. **35**:454, 1935). In social status the upper occupations (forty in all) ranked: banker, college professor, physician, clergyman, lawyer, school superintendent, civil engineer, army captain, high school teacher, foreign missionary, elementary school teacher, factory manager, machinist, electrician, drygoods merchant. At varying distances below are locomotive engineer . . . farmer . . . policeman . . . insurance agent . . . man of leisure . . . soldier . . . salesman . . . chauffeur . . . hodcarrier . . . ditchdigger. In general, the rank is closely parallel to a similar study by Counts. However, the electrician climbs from twenty-first to thirteenth place, while the man of leisure falls from fourteenth to twenty-seventh and the traveling salesman from seventeenth to the thirtieth. See also Remmers, H. H.: Bull. Purdue Univ. Stud. Higher Educ. **35**:77, 1934.

In the case of a superior person with a handicap of sensorimotor level it is often a useful principle to interest oneself in helping others who have the same handicap. But when the handicap is at the level of personality adjustment more discretion must be used. I was once acquainted with a man of brilliant attainments and cyclothymic make-up who illustrated the point in a setting with more psychologic emphasis than the condition just outlined. The man had received encouragement from lay sources to enter the psychopathologic field, where his insight from personal experience should be of special benefit to others. What often happened was that the feelings of insufficiency created a need to amplify the gulf between him and his charges, holding up to mild derision the latter's adjustmental discomfiture in settings of demonstrations to others. This man's personal honor was as unquestionable as his intellectual attainments, and there is no doubt that if he had understood—as in those days fewer did than now—the relations that feelings of insufficiency have to a Thersites complex [5] he would have achieved more social sublimations.

However distinct the trait, the mechanism of the Thersites complex in its relation to the level of intelligence and to consciousness is still highly speculative. But aside from crudely sordid ends (as sometimes imputed to the lawyer scaring his client), feelings of insufficiency do thus give an understandable motive for scaring the patient. So do sadistic trends that are incompletely sublimated. Thus, in one instance I observed that it was necessary to dispense with an amiable and professionally competent medical adviser because he seemed unable to treat a common cold without talking of encephalitis or a stomach ache without talking of infantile paralysis. There again it would have been of benefit to all concerned had the background of this attitude been understood.

In like manner, perhaps more intensively, one can use the case method on the positive side. One could balance the instances named with others that are models of excellence of applied psychology. I have more than once been under care that could serve as a one way screen or talking movie demonstration for the purpose. It is particularly important when the patient has to carry out most of a long course of therapy himself and the faithfulness with which he carries it out depends on the attitude that the physician elicits. In this connection psychology probably has something to offer in improving the manner in which physicians' directions are given and consequently the effectiveness with which they are carried out. One recalls a maxim of military art that

5. This is pursuant to the psychoanalytic Oedipus and Electra complexes. Thersites was a clownish figure in the siege of Troy, who made slurring remarks on the grief of Achilles over the death of the queen of the Amazons, slain by him in combat. This so incensed Achilles that he killed the mocker.

"if an order can be misunderstood it will be;" moreover, the physician should not overestimate his patient's comprehension or logical memory span. Verbal directions are notoriously hazardous when business profits are at stake; they are hardly less so when it is a question of human well-being.

The pattern of training pertinent to these situations has for its basis the student's best possible understanding of his own personality. This is probably the best introduction to psychology available for any one, the obstacles to its more general, even academic, use being tradition, the special qualifications required to handle it and the time it consumes. None of these objections is properly applicable in the training of the most responsible professional class in the community. There are, however, two points that call for special emphasis: 1. Such training must be based largely on individual conferences, and the utmost discretion must be assured that the biographic confidences of students are in no way exploited in the interest of an instructor's will-to-power. 2. The immediate goal is better insight into one's mental endowment; the further object, however, is to make this insight effective in the management of patients, and to this end its meanings must be rather specially formulated in terms of contacts with patients—the case method again. The student must understand as concretely as possible how his brand of ego-striving will tend, unsublimated, to exploit his patients. I have mentioned a few instances of how it does so; any experienced practitioner can enlarge on them, but they should suffice to make clear the kinds of exploitation involved. The teaching would probably also pay attention to the different personal reactions to illness that will be met among patients, self-pity for example, and the lines along which they are to be dealt with.

The question may be raised of how far such teaching as here considered might be looked on as a premedical subject. Everything technically informational could probably be included, and though adequate provision therefor may not now exist, it would not be hard to make. The orientational phase could hardly be dealt with premedically; indeed it should come rather late in the medical course, because the student's outlook needs to be as mature as possible. It is obvious then that not all teaching of what is here conceived of as psychology needs to be given, if indeed it could be given, by a single person. When practicable, there are advantages in meeting such a topic at the different angles from which different personalities approach it.

This is what medical teaching has long aimed to do in lectures on the practice of medicine, medical ethics or similarly worded subjects. I have listened to several lectures given by men to whom it was a privilege to listen on any subject; but as dynamic factors in the professional conduct of students the effectiveness can scarcely be more than

that of lectures to children in adolescence on the so-called facts of life. All the physicians mentioned must have had as good experience as the profession affords in this respect. The inspirational technic can doubtless induce good professional attitudes; the translation of the attitudes into terms of treating the sick is still the province of medical psychology to learn and teach.

Much of what has been said here applies also at the level of nursing, and with the authority that the medical profession assumes here goes a natural responsibility for the rôle of human understanding in nurses' training. My colleagues and I are working out a scheme of teaching by which actual nursing episodes of positive and negative character are treated in their psychologic implications, as already noted. Then there is the problem of a more effective psychologic approach in the routine of the clinic as it affects patients' attitudes, but it is hardly a topic to take up at the close of one's remarks. In my own community, the Worcester State Hospital has been especially interested.

SUMMARY

The physician is the adviser most trusted in all types of social situation. Every one desiring a first rate foundation for doing what will be expected of the medical practitioner should have, among others, the following accomplishments: He should know what means are available for understanding the mental capacities of individual human beings; he should know their uses and limitations and he should know when and how to avail himself of them. He should also understand something of the rôle which this professional pursuit plays in his own personality trends and the subtler as well as cruder temptations to exploit the patient in his own interest which come to every one from whom another seeks help. In every branch of medicine one meets the problems of adjustment of the organism as a whole. But the problems are the special interest of neuropsychiatrists, and to equip the members of the medical profession to deal with them is their responsibility. This means, on the one hand, a not very difficult mastery of technic and, on the other hand, that more difficult understanding of self which controls one's understanding of others.

What, for example, could have led any one (Mencken, I believe) to generalize that as a class gynecologists know particularly little about women? Very likely a train of thought such as this: The specialty in question includes, as Mephistopheles observed to the student, an institutional sanction for types of contact normally under heavy tabu. It thereby offers an inducement to any one whose impulses and inhibitions require these institutional sanctions for setting the tabu aside. The whole profession of medicine provides institutional sanctions of a much

wider nature, and there is no reason to doubt that this has made psychopathology, both medical and nonmedical, attractive to many neurotic personalities. One need not share the pessimism of Nothnagel that "only a good man can be a good physician," but the value of moral insight for such problems as involve total adjustment of the personality is open to little question. There can be no department of medicine in which usefulness depends in larger proportion on the character and temperamental fitness of the practitioner. Rather than a "frail sister,"[6] it is fitting that neuropsychiatry be in these respects a special source of example and precept to the medical profession. Noblesse oblige.

6. Coghlan, R.: Am. Mercury **14**:1, 1928.

"An Appreciation"

CHARLES LOOMIS DANA

BERNARD SACHS, M.D.
NEW YORK

Let others record more fully Charles Loomis Dana's contributions to the progress of neurology and psychiatry in America. I wish to write of him as the man with whom a small group were in close touch for more than forty years—a group that admired and respected him for his exceptional talents and his splendid character. Sincere, but sometimes caustic in his criticism, he was always just and genuinely human.

Dana was not merely a fine physician and a great neurologist; he was a man of extraordinary ability as a writer, a lover of the classics, ancient and modern, and a connoisseur of the arts, having a most unusual familiarity with the art of ancient and modern times.

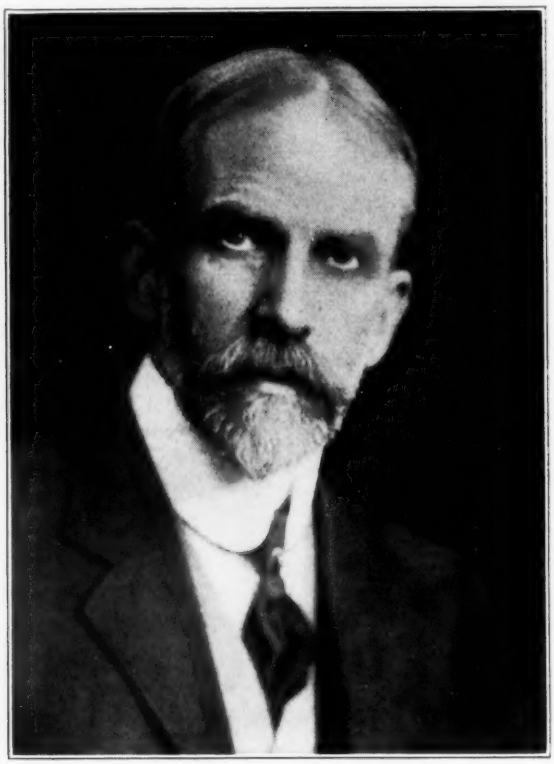
It was due to his extraprofessional interests that in 1898 he persuaded Joseph Collins, Frederick Peterson and myself to meet, at first informally, and later to organize as a club to which in 1900 the name of Charaka was given. Soon after the formation of this club, Pearce Bailey, Ward Holden, Billings, Pilcher, Arpad Gerster, George F. Shrady, William Osler and a number of other prominent physicians were added to the membership. It was Dr. Dana's stimulating and intelligent guidance that kept the members closely united these many years. He was president until the club had gained a very definite existence, and no one else was thought of in that position. The club was Dana's creation. That may seem to some a matter of second rate importance, but if I were to compare it with any other of his many activities it would be with his founding and his guidance of the Public Health Relations Committee of the New York Academy of Medicine. As chairman of that committee, he was an inspiring influence to many colleagues, who benefited by his learning and by his sincere devotion to the best interests of the entire community.

Two members of the Charaka Club have paid such splendid tribute to Dana's influence and charming qualities that I wish all to know what they have written. In a recent number of *Science* (**82**: 607, 1935), Dr. Peterson said:

> He was an unusually clear thinker and expositor of his ideas and a most excellent teacher. . . . His intimates found him a kindly, genial, loyal friend, ready to help those in need of help and to further innumerable enterprises for the public good.

Much of this article is part of a tribute paid to the memory of Dr. Dana at a meeting of the Charaka Club on Jan. 15, 1936.

Dr. Peterson gave a list of Dr. Dana's contributions to the *Proceedings of the Charaka Club,* and among these were: "The Cult of Aesculapius" and "The Evil Spoken of Physicians" in volume 1; "The Medicine of Horace" (Dr. Dana was always a great devotee of Horace) in volume 2, and "When Apollo Strikes the Lyre" in volume 3. In the succeeding volumes appear "The Costume of the Ancient Greek Physician," "Military and Civil Surgery Among the Ancient Romans,"



CHARLES LOOMIS DANA

"Eminent Physicians: A Statistical Study"; "Ursinus, the Father of Opotherapy" and "Sonnet to Clio (as Muse of Historical Medicine)."

The second tribute was not intended for publication, but Dana himself thought so well of it that he wished it to be included in any obituary notice, and I think he was right. It was contained in a letter which Dr Tilney addressed to him at the time when Dana decided that he must withdraw from the Neurological Institute. Tilney said in that letter:

> It is probable that you do not even begin to guess what an inspiration you have been and still are to so many of us. We look up to you as the high water-

mark of neurological achievement and scholarship. You, above everyone else, have been willing to give most liberally of your time and effort and interest not merely to the development of neurological science but to the stimulating efforts which have been the mainstay of constructive neurological leadership in New York.

This, in a very inadequate way, expresses the feeling of all your colleagues both young and old.

It seems to me that without you we shall be deprived of the wisdom, foresight and the keen appreciation of the still undeveloped possibilities in neurology.

In conclusion, he stated:

I write from a very full heart in an admiration and affection for you grown out of some of the most pleasant and helpful associations in my life.

I am certain that every neurologist would re-echo these sentiments.

All this has to do with Dana the man and friend. I may remember Dana as president of the Academy of Medicine and of the American Neurological Association and as speaker in Edinburgh when he delivered the Hughlings Jackson Lecture, but I can never forget him as the presiding genius of the Charaka Club and as chairman of the Public Health Relations Committee. His achievements as a neurologist were among the very greatest.

It was no mean effort to have written a treatise on nervous diseases which passed through ten editions and has been of greatest possible use as an authoritative guide to the experienced neurologist and as an absolutely sound source of information for the students of neurology.

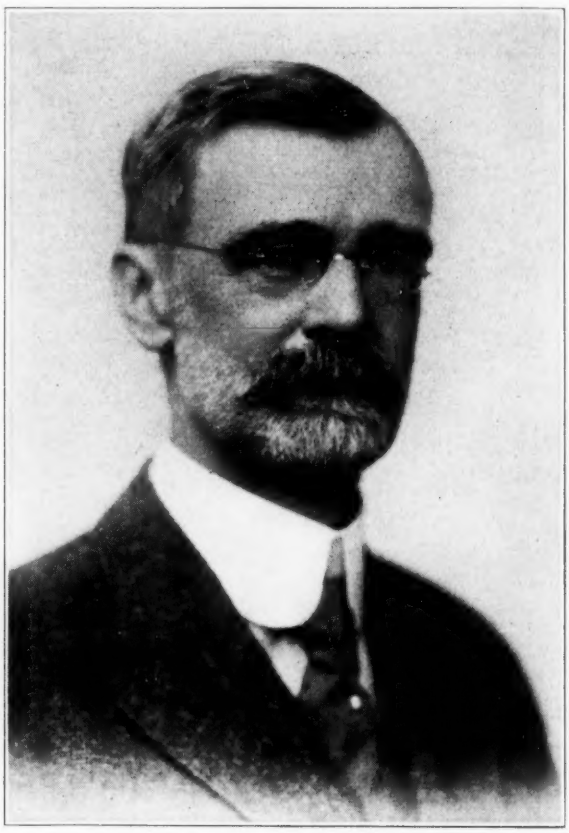
Dana's family has very wisely compiled a list of fully two hundred and fifty of his publications, and this list includes his contributions to the study of various forms of spinal sclerosis and of the degenerative diseases of the spinal cord, the very excellent contributions on the pathologic picture of the choreas and of shaking palsy and his article entitled "Subacute Combined Sclerosis of the Spinal Cord, and Its Relation to Anemia and Toxemia," which was published in 1889. A number of his articles deal with the various forms of apoplexy and of epilepsy, with the cure of early dementia paralytica, written, by the way, as long ago as 1910; with the modern view of heredity, with the somatic causes of psychoneuroses, and with myasthenia gravis. His work also includes his always well written summaries of the work of Dr. Beard, of the Seguins of New York, and of Charcot; his historical survey of early neurology in the United States, given in the Hughlings Jackson Lecture, and contributions on such general subjects as nervous and mental diseases and the Volstead Law.

The community, the medical profession and especially the science of neurology and psychiatry have lost a great and helpful worker. Let him be remembered as a sound thinker along neurologic and psychiatric lines, but above all as a brilliant exemplar of the scholar in medicine.

Obituaries

HOWELL TERRY PERSHING
1858-1935

The medical profession lost one of its most charming personalities as well as one of its most able neurologists in the death of Howell T. Pershing on Nov. 29, 1935. Despite the fact that Dr. Pershing had been



HOWELL TERRY PERSHING
1858-1935

in poor health for several years, he continued in active practice up to the time of his death.

Dr. Pershing was born in Johnstown, Pa., on March 18, 1858. He completed the regular public school course in Johnstown and then attended the Lafayette University, where he received the degree of Ph.B. in 1878, and M.S. in 1881. He studied medicine at the University

of Pennsylvania and received the degree of Doctor of Medicine in 1883. In 1908 Lafayette University bestowed on him the degree of LL.D.

After his graduation from college he taught for several years the subjects of natural science, French and German at the Wilkes Barre Academy. He was also master of science at the Lawrenceville School for Boys from 1884 to 1889. He started the practice of his chosen specialty, neurology and psychiatry, in Denver and, with Dr. Eskridge, quickly established high standards for neurology and psychiatry. He engaged in teaching at the Gross Medical College and served as professor of neurology at the University of Colorado Medical School from 1911 until his retirement in 1932. He took an active part in all local medical organizations and was chairman of the Section on Nervous and Mental Diseases of the American Medical Association in 1904. He was admitted to the American Neurological Association in 1892 and was made an associate member in 1933.

He was the author of a textbook, "The Diagnosis and Treatment of Nervous Diseases," and he contributed chapters to many of the systems of medicine, especially prominent being "Disorders of Speech," which was a part of the "Twentieth Century Practice of Medicine" and "Treatment of Diseases of the Peripheral Nerves," in 1913, for Forchheimer's "Therapeusis of Internal Diseases."

Dr. Pershing was a gentleman of the old school and a scholar and was always loyal to the highest medical ideals of his specialty. He was an excellent teacher and clinician, equally beloved by medical colleagues and patients. He played a prominent part in the organization of the University of Colorado Psychopathic Hospital. His passing leaves a gap among the physicians of the Rocky Mountain region which is irreparable.

He married Miss Anna Smith in 1884, who, after a prolonged period of invalidism and blindness, preceded him several years in death. He is survived by one son, Dr. Howell T. Pershing Jr., and two brothers, Dr. Cyrus L. Pershing of Denver and E. H. Pershing, now in Honolulu.

FRANKLIN G. EBAUGH, M.D.

News and Comment

AMERICAN BOARD OF PSYCHIATRY AND NEUROLOGY, INC.

The annual meeting of the American Board of Psychiatry and Neurology, Inc., was held in New York on Dec. 28 and 30, 1935. All the directors and officers were reelected for the following year. The following diplomas were granted:

CLASS I. *Without Examination.*—In Psychiatry: Elizabeth Ingram Adamson, New York; Clarence Alden Bonner, Hathorne, Mass.; Abraham A. Brill, New York; Ralph Miller Chambers, Taunton, Mass.; Frederick W. Dershimer, New York; Roderick B. Dexter, Foxborough, Mass.; E. Van Norman Emery, New Haven, Conn.; W. Scott Farmer, Nashville, Tenn.; Lonnie Oliver Farrar, Worcester, Mass.; Samuel W. Hamilton, White Plains, N. Y.; Robert H. Haskell, Northville, Mich.; Merle Q. Howard, Wauwatosa, Wis.; Frank Elliott Leslie, Northampton, Mass.; Alfred Berthier Olsen, Battle Creek, Mich.; Winfred Overholser, Boston; Harlan Lloyd Paine, North Grafton, Mass.; Frederick W. Parsons, Albany, N. Y.; Walter Rapaport, Imola, Calif.; James Merle Robbins, Kenilworth, Ill.; Thomas A. Rutherford, Clarks Summit, Pa.; Harry A. Steckel, Syracuse, N. Y.; George S. Stevenson, New York; Geneva Tryon, Dorchester Center, Mass.; Chester Waterman, Norwich, Conn.; Gregory Zilboorg, New York; Roy L. Leak, Middletown, Conn.; Thomas Asbury Ratliff, Cincinnati; Charles Edward Thompson, East Gardner, Mass.; W. Franklin Wood, Waverly, Mass.

In Psychiatry and Neurology: Truman James Allen, Brandon, Vt.; William E. Ash, Council Bluffs, Iowa; Inez A. Bentley, New York; Siegfried Block, New York;* L. Beverley Chaney, New York; C. Burns Craig, New York; Ira A. Darling, Warren, Pa.; John B. Doyle, Los Angeles; Clarence B. Farrar, Toronto, Canada; William Emmett Gardner, Louisville, Ky.; Alfred Gordon, Philadelphia; Daniel Percy Hickling, Washington, D. C.; George Hall Hyslop, New York; Thomas Lee Long, San Francisco; Edward E. Mayer, Pittsburgh; Whitman Carlisle McConnell, St. Petersburg, Fla.; Hugo Mella, St. Cloud, Minn.; Clarence A. Neymann, Chicago; Charles Ricksher, Norwich, Conn.; Albert B. Siewers, Syracuse, N. Y.; Harry Caesar Solomon, Boston; Walter Timme, New York; Claude Uhler, Farnhurst, Del.; Henry R. Viets, Boston; Henry W. Woltman, Rochester, Minn.

In Neurology: Clarence O. Cheney, New York; Josephine B. Neal, New York; William Alanson White, Washington, D. C.

CLASS II. *With Examination.*—In Psychiatry: Leslie Robert Angus, Hartford, Conn.; Joseph Eagle Barrett, Boston; Riley H. Guthrie, Boston; Leland Earl Hinsie, New York; Gerald Frederick Houser, Boston; Frederick Le Drew, Mattapan, Mass.; Frederick Lorimer Patry, Albany, N. Y.; Purcell George Schube, Boston.

In Psychiatry and Neurology: H. Houston Merritt, Boston; Gaylord Palmer Coon, Foxborough, Mass.; Charles Patrick Fitzpatrick, Provience, R. I.; Jacob Kasanin, Howard, R. I.; Tracy Jackson Putnam, Boston; Samuel Reback, New York; David Rothschild, Foxborough, Mass.; Robert Williams Southerland, Brentwood, N. Y.

In Neurology: David Irving Arbuse, New York; Benjamin Finesilver, New York; Max Helfand, New York; Isaac Shapiro, Schenectady, N. Y.; Paul Ivan Yakovlev, Palmer, Mass.; Carl Phillip Wagner, Hartford, Conn.

* Deceased.

AMERICAN PSYCHOANALYTIC ASSOCIATION

The American Psychoanalytic Association, which was founded in 1910, met in Boston on Dec. 28, 1935, and adopted a new constitution through which it became a federation of the Boston Psychoanalytic Society, the Chicago Psychoanalytic Society, the New York Psychoanalytic Society and the Washington-Baltimore Psychoanalytic Society. The following officers were elected: honorary president, A. A. Brill, M.D., New York; president, C. P. Oberndorf, M.D., New York; vice president, Isador H. Coriat, M.D., Boston; secretary, Ernest E. Hadley, M.D., Washington, D. C., and treasurer, Leo H. Bartemeier, M.D., Detroit.

The program at this meeting consisted of the following papers: "Humor and Hypomania," by Isador H. Coriat, M.D.; "A Contribution to the Psychogenesis of Migraine," by Frieda Fromm-Reichmann, M.D.; "The Omission of Grief: Contributions to the Psychology of Affects," by Helene Deutsch, M.D.; "Envy of the Mother and the Wish to Take from Her," by Catherine L. Bacon, M.D.; "Psychoanalytic Aspects of Some Gynecological Disorders," by Karl Menninger, M.D., and "A Case of Compulsive Masturbation," by John A. P. Millet, M.D.

AMERICAN ASSOCIATION ON MENTAL DEFICIENCY

The American Association on Mental Deficiency will hold its sixtieth annual meeting at the Hotel Jefferson, St. Louis, on May 1, 2, 3 and 4. The Friday sessions will be devoted to the general and sociologic aspects of mental deficiency, and the Saturday sessions, to psychologic and educational topics, with special stress on educational disabilities. The Monday sessions will be given over to the research activities, medical aspects and administrative problems in mental deficiency. The program will include the following papers: "Sterilization," by Popenoe; "Social Security," by Goddard; "A National Program," by Hincks; "Public Welfare," by Kirkbride; "Social Service," by Hackbusch; "Education," by Vanuxem; "Teaching Technic," by Berry, and "Research Problems," by Humphreys. All interested in the mentally defective or retarded child are invited to attend the sessions. The complete program may be obtained from the Secretary, Dr. Groves B. Smith, Godfrey, Ill.

POSTGRADUATE COURSE IN NEUROPSYCHIATRY IN GENERAL PRACTICE

Dr. Israel Wechsler, of New York, and Dr. J. W. Kernohan, of the Mayo Clinic, will cooperate with members of the staff of the Menninger Clinic in a postgraduate course to be held at the Menninger Clinic, Topeka, Kansas, from April 20 to 25, 1936. The subject will be "Neuropsychiatry in General Practice," and the outline of the course will conform essentially with that of the course given last year. Lectures, case studies and seminars included in the five and a half days of the course will be expressly directed to the application of modern neuropsychiatric principles in cases such as the general practitioner frequently observes. Enrolment is limited to thirty.

Abstracts from Current Literature

Anatomy and Embryology

TASTE FIBERS AND THE FIFTH NERVE. RUTH E. WIRTANEN and J. M. D. OLMSTEAD, J. Comp. Neurol. **60**: 1 (Aug.) 1934.

Neurologists in general agree that the taste buds on the anterior two thirds of the tongue are innervated exclusively by the seventh nerve. Some physiologists believe that the fifth nerve innervates these taste buds by way of the great superficial petrosal nerve and the vidian nerve. Wirtanen and Olmstead cut the vidian nerves in the cat to see if degeneration took place in the taste buds. The left vidian nerve was cut in fifteen cats. Autopsy showed that in six cases the nerve had been completely severed. In none of these was there absence of taste buds on the side operated on. Three operations on the gasserian ganglion were performed on three dogs. One operation was entirely successful. In this animal there was no change in the number or distribution of taste buds on the side on which operation was performed. Since division of the vidian nerve in the cat and uncomplicated removal of the gasserian ganglion in the dog do not lead to disappearance of taste buds in the anterior part of the tongue, it is concluded that taste fibers do not pass to the brain by way of either of these structures.

ADDISON, Philadelphia.

TOPOGRAPHICAL RELATIONS OF CORTICAL LESIONS TO THALAMIC NUCLEI IN THE ALBINO RAT. W. H. WALLER, J. Comp. Neurol. **60**:237 (Oct.) 1934.

The purpose of the experiments was to determine the origins of the thalamocortical fibers in the rat by a study of the Nissl substance within the cells of the dorsal nucleus of the thalamus. Cortical lesions were made in the brains of thirty-six albino rats. The animals were killed after from four to seventeen days and the brains treated by Huber's technic. The best results were seen in the period between ten and seventeen days. All parts of the neocortex, with the possible exception of the extreme anteromedial corner of the hemisphere and the region immediately above the rhinal fissure, receive fibers from the dorsal nucleus of the thalamus. Thalamocortical fibers arise in the anterior, ventral and lateral nuclei, in the dorsal nucleus of the lateral geniculate body and in the medial geniculate body. None could be demonstrated as coming from the medial, posterior or pretectal nuclei or from the nuclei of the midline. The amount of intermingling of fibers between the several thalamocortical systems seems to depend on the intimacy of relationship between the thalamic nuclei from which those systems arise. A map of the cortex of the rat based on thalamic connections shows differences from the classic maps of Fortuyn and of Brodmann. Waller suggests a restudy of the cortical cytology with particular reference to the supragranular layers and the use of the thalamocortical radiation map as a check.

FRASER, Philadelphia.

THE RELATIONSHIP BETWEEN THE CIRCUMOLIVARY PYRAMIDAL FASCICLES AND THE PONTOBULBAR BODY IN MAN. ROY L. SWANK, J. Comp. Neurol. **60**:309 (Oct.) 1934.

Swank wished to determine the frequency of occurrence of circumolivary fascicles and striae of the pyramidal system and of the pontobulbar body. Eighty-five human brain stems were examined grossly. One showing a prominent fascicle and another having well defined striae were studied microscopically. Five of the brain stems presented a distinct circumolivary fascicle on the left side, and four presented such a fascicle on both sides. In thirty-five brains circumolivary striae

were identified. If unilateral, the striae appeared on the left side only, but they were more often bilateral. The circumolivary striae were distinguished from ventral external arcuate fibers by the acute angle with which they arise from the lateral side of the pyramids and by the circular course inferior to the olive which they take.

Fifteen brains showed a prominent pontobulbar body and five showed bilateral bodies. In four brains the pontobulbar body was followed from the edge of the floor of the fourth ventricle around the restiform body and onto the pons as far as the region of the fifth nerve.

The circumolivary fascicle, when studied microscopically, was seen to terminate in the pontobulbar body and lateral reticular nucleus. Small scattered nuclear masses located dorsolateral to the lateral reticular nucleus apparently receive some fibers from it. Microscopically two more pontobulbar bodies and more circumolivary fibers were identified on the right sides of the two brains. All data indicate that the circumolivary fascicle consists of fibers of cortical origin. The circumolivary striae are morphologically comparative to the fascicles. The circumolivary fibers by their connections with the pontobulbar body seem to be part of an aberrant corticopontile tract.

FRASER, Philadelphia.

A RELATION BETWEEN AXONE DIAMETER AND MYELINATION DETERMINED BY MEASUREMENT OF MYELINATED SPINAL ROOT FIBERS. DONALD DUNCAN, J. Comp. Neurol. **60**:437 (Dec.) 1934.

The purpose of this study was to show that above a critical diameter all nerve fibers are myelinated and below it all fibers are unmyelinated. Fresh nerve fiber roots for the thoracic portion of the spinal cord were obtained from healthy adult cows, cats and rats and fixed in osmic acid. Paraffin sections were prepared at from 5 to 7 microns, and tracings were made of the outside circumference of the myelinated fibers. Fifteen thousand diameters were measured. Several hundred minimum and maximum measurements gave no indication of alteration of caliber as the result of embedding after fixation in from 0.5 to 2 per cent osmic acid.

In the rat all fibers in the root were measured; in the cat approximately one-half the fibers in a given root were measured, and in the cow, only a small fraction of the total number. The fibers in the ventral roots of each species occur in two definite groups of sizes, a group of large fibers and a group of small fibers. In the cow the large fibers are larger than the large fibers in the cat and in the rat. In the cat the large fibers are slightly larger and the smaller slightly smaller than those in the respective groups in the rat. In the dorsal root of the cat and rat there are three size classes, each larger in the cat than in the rat. Grouping is not distinct in the dorsal root of the cow, but there is a large number of fibers of very fine caliber. In the cat and rat these fibers are present but are totally unmyelinated. The critical myelinization diameter above which all nerve fibers are myelinated the author concludes is between 1 and 2 microns and is the same for all mammals.

ADDISON, Philadelphia.

Physiology and Biochemistry

THE PERMEABILITY OF LIVING CELLS TO HEAVY WATER (DEUTERIUM OXIDE). BALDWIN LUCKÉ and E. NEWTON HARVEY, J. Cell. & Comp. Physiol **5**:473, 1935.

The rates of penetration of heavy water (deuterium oxide) and ordinary water (hydrogen oxide) indicated that the permeability of the cell (unfertilized eggs of the sea urchin, Arbacia punctulata) has not been greatly affected. Heavy water in sufficiently high concentration proved injurious to the cell, as was indicated by an inhibition in the development of fertilized cells. This injurious effect of heavy water is not due to rapid changes in the permeability of the cell.

CHORNYAK, Philadelphia.

IRIS-PIGMENT MIGRATION AND ITS RELATION TO BEHAVIOR IN THE CODLING MOTH. DONALD L. COLLINS, J. Exper. Zoöl. **69**:165 (Nov.) 1934.

In order to show that the differences in the responses to light of the common codling moth, Carpocapsa pomonella Linn., are dependent on changes in the position of the ocular pigment, histologic studies of the migration of the pigment were made on moths from laboratory and field stocks which had been exposed to changes of both natural and artificial light. Criteria for determining the state of photic adaptation were established. The histologic data were correlated with the activity and behavior of the moths. Under natural conditions at various periods of the year the time of onset and duration of adaptation to light and dark were recorded. It was found that there was no physiologic rhythm in the movement of the pigment independent of the influence of light, and that the moth is positively phototropic to a marked degree only when completely or almost completely dark-adapted. Correlating the observations of the habits and behavior of the living moths with the histologic data, Collins found that the state of complete adaptation to light was a period of rest, as was also the state of complete adaptation to dark. Under natural conditions the initial change from either state of adaptation to the other determined activity (feeding, mating, oviposition and migration) until the pigment had nearly completed its migration. The activity then subsided as the movement of the pigment reached its maximum. It was concluded that migration of the iris pigment is a prominent factor in determining the behavior of the moth.

WYMAN, Boston.

SPINAL SHOCK AND SOME FEATURES IN ISOLATION-ALTERATION OF THE SPINAL CORD IN CATS. E. G. T. LIDDELL, Brain **57**:386, 1934.

The term spinal shock has come to denote the cessation of movements in the extremities after transection or gross injury to the spinal cord. Although the word shock is often used to connote the deportment of the subject for the whole of the remainder of its existence after section of the spinal neuraxis, it seems preferable that the status be divided into two stages: (1) that of shock, enduring only a few hours or days after the lesion, and (2) that of isolation-alteration, a stage of amelioration and increased excitability ensuing in some species of animals after shock, during which the diastaltic and simple reflex movements appear.

As to the nature of shock itself, there is evidence that "loosening of the nexus" between higher and spinal centers leads to deficient excitability. The present experiments are interpreted in substantiation of that view.

Liddell made studies on cats at varying intervals up to sixty days after complete section of the cord at or about the level of the last rib. Before myographic examination decerebration of the animal was performed at the intercollicular level. The susceptibility of the knee jerks to single shock inhibition was investigated at various periods, and it was found that susceptibility to inhibition becomes progressively less until, after from fifty to sixty days, the recovery curve resembles that for a decerebrate cat with the spinal cord intact. Collateral evidence, derived from the degree of muscular extension needed to produce a given background of excitability, suggests restitution of the central excitatory state to almost normal values in the spinal centers. Even if real, such values for the central excitatory state are useless to the organism because the nexus with, and command from, higher centers is permanently lost.

SALL, Philadelphia.

THE ACTION OF A SINGLE VAGAL VOLLEY ON THE RHYTHM OF THE HEART BEAT. G. L. BROWN and J. C. ECCLES, J. Physiol. **82**:211 (Sept. 19) 1934.

It may now be regarded as established that the vagus nerve exerts an inhibitory action on the heart by liberating a substance which biologic tests have been unable to distinguish from acetylcholine. Three problems arise from this first important step toward a solution of this vagal action on the heart: 1. How do impulses in the postganglionic fibers of the vagus nerve liberate acetylcholine substance?

2. What factors govern the transportation of acetylcholine substance from the region of its liberation to the site of its action? 3. How does acetylcholine substance exert its inhibitory effect on the heart, e. g., how does it act on the rhythmic mechanism of the pacemaker?

In the present paper a detailed study has been made of the effect on the heart rate produced by a single volley of impulses down either the right or the left vagus nerve of the cat. Single vagal volleys were set up by applying single induction shocks to the peripheral ends of the transected vagus nerves. The heart beat was recorded electrically from the pacemaker, and it was found that a single volley in either vagus nerve always produces a slowing of the heart rate which persists for many cycles, though the maximum effect is usually on the first inhibited cycle.

If the vagal volley is set up late in a cardiac cycle, that cardiac cycle is not inhibited, the latent period of the inhibition being usually from 100 to 160 sigmas. Of this amount, the conduction time to the region of the pacemaker probably accounts for only about 10 sigmas; i. e., the greater part of the latent period appears to occur after the arrival of the inhibitory impulses at the nerve fibers of the pacemaker. It is probable that most of this time is occupied in the liberation of the acetylcholine substance and in its diffusion to the point of its action.

In order to show the time course of the inhibitory effect of a single vagal volley, curves were constructed. The shape of the inhibitory curve seems to be inherent in the rhythmic mechanism itself, for the right and left vagus nerves always give similar curves, and the submaximal inhibitory curve is similar to the maximal.

A small intravenous injection of physostigmine increases the height of the primary wave and slows the rate of its decline. It also has a similar effect on the secondary wave. The action of this drug is explained by its known inhibitory action on the esterase hydrolysis of acetylcholine substance and by the fact that both inhibitory waves are due to the action of acetylcholine substance. The latter conclusion is supported by the finding that atropine also affects both inhibitory waves similarly.

Analysis of inhibitory curves shows that the acetylcholine substance antagonizes the action of the excitement on the rhythmic mechanism—there is no irreversible inactivation of the excitement. It is also shown that the setting up of a beat by a rhythmic center does not affect the inhibition existing in that center. By comparing the rising parts of the maximal and submaximal inhibitory curves, Brown and Eccles were able to show that the concentrations of acetylcholine substance are directly proportional to the inhibitory lengthenings which they produce, provided that such lengthenings are small. Larger concentrations of acetylcholine substance seem to produce a more than proportional inhibitory lengthening.

ALPERS, Philadelphia.

FURTHER EXPERIMENTS ON VAGAL INHIBITION OF THE HEART BEAT. G. L. BROWN and J. C. ECCLES, J. Physiol. **82**:242 (Sept. 19) 1934.

In the preceding paper it was shown that a single volley in either vagus nerve produces an inhibition of the rhythm of the pacemaker of the heart. If one vagus nerve is stimulated simultaneously with, or at any time after, the stimulation of the other vagus nerve, an additional inhibition is produced. The inhibitory curve for two vagal volleys, one being in each vagus nerve, usually is identical with the sum of the primary waves of the two single inhibitory curves. There is always occlusion of the secondary inhibitory waves. When both volleys are in the same nerve and at a sufficiently long interval, the primary wave of the double inhibitory curve is also usually identical with the summated curve. Two factors seem responsible for the deficiency obtaining from stimuli applied at short intervals. The relative and absolute refractory states following the first volley diminish the effect of a second stimulus supplied at less than about 125 sigmas after the first. But in many experiments the first volley had a diminished effect at much longer intervals, even at 0.5 second. This may be due to a partial exhaustion of the mobilized acetylcholine substance in the postganglionic fibers.

Single vagal volleys were set up at varying times during premature beat cycles. Inhibitory curves were constructed from such inhibited premature beat cycles and, as would be expected, they usually appear to be identical with the inhibitory curves obtained from normal cycles. But in two experiments the inhibition of the premature beat was much less than that of normal cycles, and in one experiment the inhibition was much greater than normal, the deviation from normal increasing in all cases as the curtailed cycle was shortened.

Brown and Eccles draw the following conclusions from their experiments reported in these two papers: 1. The right and left vagus nerves are distributed independently to the pacemaker, there being no demonstrable common pathways in the ganglia or elsewhere. Impulses are conducted in the preganglionic fibers at about 30 meters a second, and the absolutely refractory period is less than 4.5 sigmas.

2. In some experiments a second volley has liberated the same amount of acetylcholine substance as the first, even when it follows at an interval as short as 12 sigmas. This supports the view that the acetylcholine substance is liberated from a preformed store. However, in other experiments a second volley produces a smaller amount of acetylcholine substance, even when it occurs at a much longer interval after the first volley. This may be due to a delay in the mobilization of the preformed acetylcholine substance.

3. It is probable that most of this time is occupied in diffusion of acetylcholine substance from the point of its liberation to the site of its action on the rhythmic mechanism of the pacemaker, but a part of the delay may occur in the rhythmic mechanism of the pacemaker. The concentration of acetylcholine substance acting on the pacemaker continues to increase for about 0.3 second, but even during this period it is being rapidly destroyed by the specific esterase present in the tissues, and after the maximum is attained this rapid enzymatic destruction continues, the concentration of acetylcholine substance being halved in every 0.4 to 0.8 second.

4. The following provisional hypothesis has been advanced: The rhythmic mechanism of the pacemaker sets up a beat when its excitement reaches a certain threshold intensity. Acetylcholine substance inhibits by acting as a quantitative antagonist to this excitement, the setting up of a beat being delayed until the excitement is built up to such an intensity that the uninhibited excitement attains a threshold value. For about 0.3 of a cycle after the normal time of a beat, the excitement increases linearly, and so the concentration of the acetylcholine substance is proportional to the lengthening of the cycle, but thereafter the excitement increases at a progressively slower rate.

5. The increase of excitement referred to in the foregoing paragraph usually follows a similar time course with premature beat cycles, but in some experiments the aberrant inhibitory curves which have been obtained with premature beat cycles seem to indicate that there has been a fractionation of the rhythmic center. A similar explanation has also been suggested for the common double wave type of inhibitory curve for which no simple explanation has proved satisfactory.

ALPERS, Philadelphia.

Psychiatry and Psychopathology

INSANITY IN ITS MEDICO-LEGAL RELATIONS TO SOME NOTABLE CIVIL AND CRIMINAL CASES. JOHN JOSEPH KINDRED, Am. J. Psychiat. **91**:137 (July) 1934.

After reviewing some notable criminal cases, Kindred concludes that there have been many convictions of insane defendants, especially when the victims of the crimes were famous or beloved persons. The author believes that Guiteau, the assassin of Garfield, suffered from paranoia, while he classifies the case of Czolgosz, McKinley's murderer, as a "case of constitutional psychopathic inferiority—paranoid." The recent Zangara case is reviewed, and Kindred, who participated in the examination and autopsy of this defendant, is inclined to classify Zangara as suffering from a "paranoid manic-depressive" psychosis. He suggests

that, had this case gone to trial, the defendant might have called attention to Dr. Tice's report of the autopsy on Mayor Cermak, which stated that the latter's death was due to ulcerative colitis. In this way, Zangara's counsel might have raised a reasonable doubt as to the effectiveness of the bullet wounds in causing the mayor's death.

The development of the present legal concept of criminal irresponsibility before and since the McNaughten case is briefly reviewed. From this review, Kindred draws the conclusion that progress in psychiatry has modified the worship of legal criteria in this field and suggests that courts are becoming increasingly willing to study each defendant as a psychobiologic unit. The constitutional right of every defendant to have his sanity determined by a jury of laymen stands as a bar, however, to satisfactory progress in this field. DAVIDSON, Newark, N. J.

CONSTRUCTIVE APRAXIA: PSYCHOLOGICAL VIEWS ON THE CONCEPTION OF SPACE. L. VAN DER HORST, J. Nerv. & Ment. Dis. **80**:695 (Dec.) 1934.

In cases of constructive apraxia the patient is usually able to accomplish the ordinary automatic tasks of life, but when asked to do something dependent on optical observation in space he fails utterly. In addition, disturbance in gnosia, in writing words and in sensing time may complicate the picture. The patient, for instance, gives evidence of understanding what he has been asked to do, both by his answers and by the way he performs the task, yet when requested to carry out such a simple procedure as putting an object lying to his left in the same position as the one lying to his right he is unable to do so. Operations in three dimensional space are carried out with even greater difficulty than operations in two dimensions. The patient does not live in a space in which the various directions can be clearly discriminated optically. The author's investigations lead him to conclude that there exists a special psychic structure enabling one to see things stereoscopically arranged in space or, in other words, possessing a direction radical. The spatial sense factor in the psyche proves to be a formal constituent of the power of perception and the power of movement. HART, Greenwich, Conn.

ADJUSTING THE DEFECTIVE CHILD. EMILY WIRES, Ment. Hyg. **18**:638 (Oct.) 1934.

The psychiatrist who knows that a state school may be the best available place for a defective child often meets with resistance from the parents at this suggestion. This attitude is probably an overcompensation for a feeling of guilt on the part of the parent. In explaining to the father or the mother why the home is unsuitable and the state colony desirable the physician should point out that the retarded child is unpleasantly conspicuous at home, that he adversely affects the normal siblings, that he is likely to be overprotected, that his opportunities for play will be restricted, that he will be denied companionship and that he will generally be rejected by his family, school and neighborhood. The physician, on the other hand, can point out the advantages of the state school. Because of superior supervision more freedom is allowed during play. Training, both scholastic and vocational, is likely to be well suited to develop any capacities the subject may have. Companionship is provided, and it is a companionship of his peers. There will be no embarrassing rivalry, no teasing and no conspicuousness. Under such training, the child may be made into a useful member of society and later returned to his home, or to a home provided by the school, becoming a social asset instead of a family liability.

DAVIDSON, Newark, N. J.

RESULTS OF HABIT TRAINING. ROSS E. HEROLD, Psychiatric Quart **8**:511 (July) 1934.

A routine of regular, detailed, habit training was instituted in a ward with 200 patients, all of whom had been inmates for more than two years. Most of them had schizophrenia. The basic routine was identical at the start. On awakening,

each patient was placed on a toilet-seat until excretion had occurred. The patient was then placed at a wash-stand equipped with brushes, soap and towels; an attendant placed the proper utensils in the patient's hands and instructed him in the motions by making the movements passively with the patient's extremities. It was necessary to carry out this routine in identical order and method day after day. In time most of the patients mechanically went through the proper motions of washing when the equipment was placed in their hands. In the dining room a similar procedure was followed, the utensils being placed in the patient's hands and an attendant operating the hands until the motions became automatic. Those who improved sufficiently were trained to make beds, clean floors and wash dishes, the training being carried out in a similar fashion. In 15 per cent of the cases there was no, or very little, improvement. In 54 per cent there was definite improvement, although not enough to permit the patient to engage in regular work at the hospital; in 31 per cent there was great improvement—enough to permit the patient to perform some work at the institution.

DAVIDSON, Newark, N. J.

THE VALUE OF AN ORIENTATION LETTER FOR NEWLY-ADMITTED PATIENTS. TAMARA DEMBO and EUGENIA HANFMANN, Psychiatric Quart. **8**:703 (Oct.) 1934.

To reassure and orient the newly admitted patient, the superintendent of the Worcester State Hospital in Massachusetts has devised a letter which is delivered personally to every patient entering the hospital. The effects of this letter on fifty men and fifty women were studied by Dembo and Hanfmann, who delivered the message in person and noted the patient's response. The text of the letter is given in full in the original paper. It is a carefully worded, kindly document, simply written and highly informative. Seventy-seven of the patients actually read, or had read to them, the contents of the letter. In six cases, the reading was postponed. In the remaining seventeen instances, various physical factors such as acute illness or difficulty in understanding the language prevented the transmission of the contents of the message; mental factors prevented the communication of the letter in only three of the cases. Of the seventy-seven patients who received the contents of the document, sixty-one understood it completely, eight understood it partly, four understood it doubtfully and four did not understand it at all. The letter served a positive function in seventy-one cases; that is, it served to orient the patient toward the hospital and its routine or served to assure or comfort him. In four cases it had a negative effect; that is, it confirmed the patient's illness, stressed his incarceration or was interpreted delusionally. In the remaining cases its effect was neutral.

DAVIDSON, Newark, N. J.

PSYCHOANALYSIS OF PHARMACOTHYMIA. SÁNDOR RADÓ, Psychoanalyt. Quart. **2**:1, 1933.

Radó states that the psychoanalytic study of the problem of drug addiction begins with the recognition that not the toxic agent but the impulse to use the drug makes an addict of a given person. Addiction to drugs is therefore psychically determined. It is an artificially produced illness brought into being for psychic reasons. From this standpoint all types of craving for drugs must be regarded as varieties of one single disease, for which Radó introduces the term "pharmacothymia." From the older psychoanalytic literature two conclusions can be drawn regarding this disease: the etiologic importance of the erotogenic oral zone and the close relationship to homosexuality.

Pharmacothymia occurs because there are certain drugs which may allay and prevent pain or may permit or generate pleasure, both serving the pleasure principle and both available to a human being in psychic distress in order to influence his emotional life. The pharmacothymic patient wishes the toxic agent to produce a pleasure effect. Since this costs him severe suffering, self-injury and often self-destruction, it must be that the pleasure gained is worth the cost or that he is in a trap and is forced to act as he does.

These persons belong to the group that react to some physical illnesses or to life frustrations by a special type of emotional alteration, which Radó designates as "tense depression;" it is marked by great painful tension and a high degree of intolerance to pain. In this state of mind psychic interest is concentrated on the need for relief. In this state if the person finds relief in a drug he is properly prepared to be susceptible to its effects. The pleasure effect of the drug produces at this time a sharp rise in self-regard and an elation of mood. The elation is a reaction of the ego to the pleasure effect, and in the evolution of a pharmacothymia it is essential that elation should develop. In the course of development the ego has had to relinquish its original narcissism and to enter on a realistic regimen, wherein gratification is based on achievements. The ego in tense depression compares its current helplessness with its original narcissistic stature (which persists as an ideal), torments itself with self-reproaches and aspires to leave its tribulations and regain its old magnitude. The miracle comes to pass through the pharmacothymic pleasure effect which is brought about by the ego itself. In pharmacothymic elation the ego regains its original narcissistic stature.

At the height of the elation, interest in, and respect for, reality disappear. All the ego's desires which work in the service of reality are neglected, and there erupts the striving to bring to the surface and satisfy all the unsatisfied instincts that are lurking in the background. This miracle lasts only a few hours and is followed by an inevitable alteration of mood. In other words, the initial depression returns, exacerbated by the contrast between the present demands of reality and the previous omnipotent feeling. In addition to the remorse for having disregarded activities which may have been present in the initial depression, there are now an increased fear of reality and a sense of guilt for having been completely disdainful of real requirements. The ego is therefore more irritable and, because of increased anxiety and bad conscience, weaker. It grieves for its lost bliss, and this longing is destined to be victorious. The pains of the pharmacothymic depression give birth to the craving for elation.

Thus a cyclic course is developed with the ego now maintaining its self-regard by artificial means. The subject's life changes from a realistic regimen to a pharmacothymic one. This regimen has a definite course which necessarily restricts the ego's freedom of action. It is interested in only one problem, i. e., depression, and in only one way of attacking it—the administration of the drug. The illness, therefore, is a narcissistic disorder—a destruction through artificial means of the natural organization of the ego. This method is insufficient, however, for although the depression returns with regularity the elation becomes necessarily undependable and in the end threatens complete nonappearance.

It is not certain why the return of the elation diminishes. This is probably a chemical question, but psychologically the patient's fear that the drug will be inefficacious contributes to it. The patient attempts to compensate by increasing the dose, and so his whole life and activity are devoted to securing drugs sufficient to subdue the depression. The sexual life is greatly affected. First there is lessening of sexual potency—a brief augmentation followed by a turning away from sexual activity. In place of the genital pleasure the dominant sexual aim becomes the pharmacothymic pleasure effect—an artificial sexual organization which is auto-erotic and modeled on infantile masturbation. Love objects are no longer needed but are retained in fantasy, the fantasy returning regressively to the oedipus situation. The pharmacothymic pleasure effect discharges the libidinal tension associated, and these fantasies and others come to replace the natural sexual executive.

The ego responds to this destruction of the natural sexual organization with a fear of castration as a warning signal due to the narcissistic investment of the genital. Anxiety about the genital must compel abstention from the dangerous practice. The ego has sold itself to the drug and does not heed the warning, but it is unable to suppress the fear which it perceives as fear of pharmacogenic failure. By frivolously cutting itself off from all social and sexual activities, the ego gives itself over to masochism (the effect of the death instinct).

In the initial depression the ego has felt the power of this instinct and partly for fear of it has adopted the pharmacothymic regimen. This regimen, however, does not strengthen the ego by entrenching its narcissism, but bestows on it a valueless inflation of narcissism which soon collapses. Elation can no longer be provided to combat the depression, and a pharmacothymic crisis develops. There are three ways out of this crisis: flight into a free interval, suicide or psychosis. The patient does not submit to a free interval because he has a real desire to recover his health, but rather to rehabilitate the depreciated value of the drug. The withdrawal of the drug divests the ego of its elation which has been its protection against masochism. The masochism invades the ego and exploits the physical symptoms due to abstinence to the point of a masochistic orgy. Suicide is the work of the self-destructive masochism, but there is another motive for suicide than the masochistic need for punishment. The lethal dose is taken to dispel the depression by an elation which will last forever. The patient does not kill himself; he believes rather in his immortality. Furthermore, in suicide through drugs the masochism is victorious as a feminine instinctual demand.

The psychotic episode has the following framework: The ego is robbed of its protective elation by the failure of the pharmacothymic regimen. Masochism crowds into the foreground, and horrible hallucinations and deliria of persecution by castration or sexual attack gratify the masochistic wishes. Of course, these masochistic pleasure wishes are transferred into error fantasies by the ego.

If the anxiety which protects the ego from masochism breaks down, then as the ego accedes to the masochism the patient may inflict injuries on himself, which may be either the destruction of the genital or of a substitute for it. Masochism in pharmacothymia may be alternated into the passivity of a homosexual attitude. The genital eroticism combines with the masochism to form a compromise which will combine the genital aim of painless pleasure with the passive behavior of masochism and this results, in men, in a homosexual choice of object, the homosexuality being of the passive type. This change from male heterosexual normality to active homosexuality is by a three stage process: (1) weakening of genital masculinity and a corresponding reactive increase in the antagonistic masochism, (2) the confluence of genital pleasure and masochism in the compromise, passive homosexuality and (3) the development of homosexuality from the passive to the active form as the result of a vigorous reparative action on the part of the ego.

In the first stage the heterosexuality may be preserved by choosing another compromise solution and becoming oriented passively toward women. This erotic position is quite unstable, but it can be reenforced by an infusion of fetishism to withstand the onslaught of castration anxiety. With the aid of the fetishistic mechanism the beloved woman is in imagination transmuted into the possessor of a penis and elevated to take the place of the "phallic mother." Correlated with this, the emotional tone in regard to the genital region of women is disturbed by a sort of discomfort, and the patient assiduously avoids looking at it or touching it. A further intensification of the masochistic wish to be castrated, or better, of the fear of castration aroused by this wish, then forces the patient either to be abstinent or to follow the homosexual course and exchange the partner without a penis for one who possesses a penis, as in the second stage.

Again the ego may refuse to adopt as a solution the compromise of any passive orientation. It may respond to the danger proceeding from the masochistic instinct by a reaction formation. Sadism is rushed to the rescue of imperiled masculinity, to shout down, by its vehemence, fear of castration and masochistic temptation. Therefore, one finds aggressive irritability, with unprovoked outbursts of hate or rage against women which in apparently unpredictable fashion alternate with states of touching mollification. The excesses of brutality are the substitutes for potency of the pharmacothymic person who is fighting for his masculinity, and his sentimental seizures are eruptions of the masochism which his pharmacothymia has reactively intensified.

In more severe, advanced cases symptoms appear which are the result of cerebral damage. If the poisons consumed have damaged the brain substance and perma-

nently impaired cerebral activity, this is perceived in the mental sphere as a disturbance of the elementary psychologic functions. The psychic organization reacts with an effort to adapt to this fact and correct the result.

There are abortive forms of pharmacothymia. The patient may retain the realistic regimen and use his pharmacothymic regimen only as an auxiliary and corrective. He desires in this way to make up for the uncertainty in his realistic attitude and cover a deficit by means of a counterfeit. In this group is found the normal person who makes daily use of stimulants in the form of coffee, tea and tobacco.

PEARSON, Philadelphia.

THE BODY AS PHALLUS. BERTRAM D. LEWIN, Psychoanalyt. Quart. **2**:24, 1933.

This article, based on material from an analysis of nine patients, deals with the use of the whole body as a symbol for the penis and considers the various aspects of the fantasy and its significance in sexual organization. When the body symbolizes the penis the mouth symbolizes the urethra, and any discharge from the mouth (or from other orifice of the body) represents an ejaculation. A flow of words may represent a flow of urine. This transference of urethral qualities to the mouth seems important in explaining the origin of the character trait of ambition. Ambition is a urethral and also an oral character trait, and the author concludes that it depends on the displacement of urethral qualities to the mouth when the whole body represents a penis.

The deeper psychology of this fantasy seems to be as follows: The complete fantasy is that the patient has bitten off or killed a penis, thus equating the penis with feces; that he has swallowed the feces, and that by virtue of the swallowing and incorporation he becomes one with the swallowed penis. The sexual aim of this identification with the penis, which up to this time has been a sexual object, is to play the same rôle as the penis, to be devoured, i. e., the fantasy of the whole body as a penis is a sign of the unconscious wish to be eaten. This wish to be eaten is a passive feminine fantasy, the equivalent of the phallic level fantasy of castration. This fantasy occurs as a postphallic reorganization of the component impulses into an organization the main aim of which is oral, and it has two dominant erotic goals: (1) to swallow a bodily part and (2) to be eaten.

In the cases of stammering which were studied, the oral sadistic aim was the chief or central aim in the stammering, the ideational content, to ablate the breast, being displaced by way of the equation breast = penis to the phallus. The fantasied incorporation of the phallus led to an identification of themselves with it; this in turn led to the "urethralization" and "analization" of the mouth, the "excrementalization" of the flow of speech and to stammering; i. e., when the body becomes a phallus the mouth becomes a urethra (and anus), and the stammering is a function of the reorganized libidinal arrangement. This fantasy occurs frequently and normally in cases of fever and in the early stages of pregnancy.

The statement that the whole body represents a penis is not sufficiently specific; for completeness of understanding it must be known whose body and whose penis are referred to. Mathematically speaking, there are four possibilities: (1) one's own body is one's own penis; (2) one's own body is another's penis; (3) another's body is one's own penis; (4) another's body is another's penis. The first variant is not found in cases of neuroses, but is found in cases of schizophrenia. The second is the one most frequently encountered in the analysis of persons with psychoneurosis. All the author's patients demonstrate this form of the equation: The patient identified himself with a parental phallus. Usually this phallus was the father's, but in some instances the patient identified his body with the phallus of the mother. The third variant of the equation (another's body is one's own penis) is clearly seen in the common identification of one's penis with the whole body of a child. The fourth variant (another's body is another's penis), according to Freud, is an equation by virtue of which women normally proceed in their sexual development from the desire for a penis to the desire for a mate.

PEARSON, Philadelphia.

ANXIETY WITHOUT AFFECT. GREGORY ZILBOORG, Psychoanalyt. Quart. **2**:48, 1933.

This article begins with a brief discussion of anxiety, in which Zilboorg points out that an anxiety reaction consists of three components: ideational content, feeling tone (affect) and motor reaction. Parts of this reaction may appear isolated, with the other parts repressed, in the following ways: Ideational content may appear isolated, with feeling tone and motor expression repressed; feeling tone may come into the foreground while the ideational content remains repressed, but the motor accompaniment on such occasions will all be present; the motor component may come into evidence with both ideational content and affect remaining repressed. All three components may break through simultaneously, but one mathematically possible combination appears unthinkable, i. e., the breaking through of both ideational content and motor expression without the affect involved. In connection with the last possibility, Zilboorg reports a case in which the patient in the course of analysis tenaciously resisted facing his anxiety and finally chose a mode of response which seemed to deviate considerably from what might have been expected. The patient's personality was profoundly passively oriented; his ambitions were uncrystallized and his relationships lukewarm. His sexual life showed the same uncrystallized passive orientation. During analysis his moods fluctuated imperceptibly if at all. He had dreams but either remembered only the fact that he had had a dream or recalled one or two dream fragments to which he gave no free associations. These fragments usually dealt with more or less frank hints that his attitude toward the analyst was a passive homosexual one and that he wished the analyst to have intercourse with him per anum. Attempts to interpret these dreams in the face of scanty associative material elicited a mild reaction of assent: "Yes, it must be some sort of homosexual attitude." It was apparent that the chronic standstill of the patient's affective life in and outside the analytic hours must have been due to an extremely pathologic passivity, combined with a severe reaction formation in regard to his extraordinary anxiety and possibly to some as yet undiscovered unconscious gratification which he must have been obtaining in or outside the analysis in order to keep himself in his tenacious state of pathologic psychic equilibrium. During the analysis the patient's father had a severe vascular disease with episodes of pain which kept him bedridden. At the time of one of these episodes the patient had his first consummated heterosexual love relationship, although this was as usual a passively accepted arrangement. At this time, while he was attending a lecture on clinical neurology, a man with a thalamic syndrome was presented. As the patient listened to the strange noises made by the man he had at the moment a "peculiar reaction": he felt a sort of tightness in his scrotum and the "pilomotor muscles" (the patient's own words) in the region of his pubes and on his head "sort of raised the hair." He associated this reaction with a thought of a bicycle, and at that instant the patient's voice dropped, his face became pale and his breathing became accentuated. He recalled that the instructor stroked the man's thigh. Instantaneously the pallor on the patient's face reappeared; he stated that he felt again the "pilomotor reaction" and thought of a bicycle, no, of a tricycle. He began to breathe heavily; his head began to move as if spasmodically; he said his heart was beating very fast, he could not breathe, he saw himself with a gash on his leg and his father approaching him with a knife; he also saw himself with a deep bleeding gash on his forehead and his father coming toward him with a steel knife. The incident lasted about two minutes; then the patient quieted down with a "Queer!" uttered in a low tone of voice, and almost instantaneously regained his usual serene self. He did not feel any fear during this reaction. However, the next day on leaving the analytic session, suddenly, while in the street, he felt that he was really frightened without knowing why, and ran quickly for a few steps as if running away from some danger. Following this he had two dreams. He was in a taxicab a short distance from his home. The meter was running very fast. It was not a "15 and 5" meter but x and x for each half mile, the sum representing his fee for an analytic session though he did not notice this at first. Finally the taxi stopped. The meter showed n dollars and 10 cents. He objected to paying; it

was really a ridiculously large sum; he was not angry, because he knew he was not going to pay; moreover, the policeman who was there took the patient's side.

Another dream followed immediately: He was running away from some man; there were now two and then three people. When there were two, one of them was the patient himself as a little boy of 6 or 7. When there were three, one of them was the patient watching the chase of the little boy who was a stranger to him; the man looked "perhaps somewhat" like the analyst. There was a red light which seemed familiar, but he was unable to say any more about it than that. He was running very fast and was very frightened. He finally ran into a bed; the man now was an ogre catching up with him, rushing toward him and finally leaning over him apparently ready to harm him mortally. He was terribly frightened, and just at that moment he saw the ogre transformed; it was his father, with "nice soft lips," smiling; his skin was smooth, freshly shaven and powdered. He woke up.

These dreams brought memories of fears at night when he was about 6 years of age. A little later, again at a lecture, he experienced a reaction similar to the one described but had no feeling of fear.

While the patient's psychologic problems differed little from those in many other cases his emotional reactions were unusual. In the street he experienced fear and ran, but the ideational content was completely repressed. In the dream of being chased he was aware of the affect and its motor accompaniment and of a disturbed content of his anxiety (passive homosexual wishes, concealed incestuous wishes, castration of his father and a reverberation of the primal scene), but on waking he was unable to muster up enough affective continuity to live out and gain emotional insight into his problem. He revealed how he escaped the affect. In the dream his ego rejected the content of the anxiety successfully enough to display only affect and motor response. As soon as the tension was too great he could step out of himself and watch the scene as an outsider or, as in the dream about the taxi, he would project his hate onto the driver and shelter himself under his homosexual wishes. But when castration anxiety (affect woven into ideational content) became too active so that it broke into consciousness in the form of a screen memory, too transparent to be neglected by the ego, his motor system was the first to yield, and by some tour de force he again succeeded in escaping; he felt no fear. Thus, despite the simultaneous appearance in consciousness of the content of anxiety and the motor discharge of the phenomenon of anxiety, no subjective feeling tone could be observed or elicited. This suggests an isolation of the ideational content in a particular way. It becomes foreign to the ego despite its presence in consciousness, and it is reduced to the rôle of a simple internal stimulus which releases a purely physiologic reaction. To the analyst the patient's ideas (bicycle, etc.) may seem castration imagery, but to the patient it appeared as nothing more than an indefinite, even amorphous, "something" that automatically set into play a set of primitive cardiovascular and respiratory reactions without content.

The speculative conclusion seems to be in the attempt to ward off anxiety; the patient rejected the psychologic meaning and therefore the very reality of the conflict, its representation, its conscious imagery and even its relation to himself and reverted to the most primitive form of expression, recognized as birth anxiety; i. e., he escaped from his conflict by devitalizing and rejecting not only the chief content of his conflict which broke with such suddenness into his consciousness, but any content except the physiologic.

There seems therefore a temporary total regression to the most primitive mode of response, a regression to a time when the world had no other content for the patient than an undifferentiated mass of stimuli which gave rise to a great deal of tension and which in turn had to be warded off by the only means at his disposal, i. e., a complex but primitive respiratory and cardiovascular response. Thus, the patient's reaction would probably fall under the rubric of rudimentary anxiety attacks or anxiety equivalents, as described by Freud in 1894.

Zilboorg then compares these phenomena with those observed in catatonia. Catatonic and depressed patients with paranoia go through a prestuporous phase which is characterized by a frank manifestation of anxiety. During this phase they are either perplexed, apprehensive or timid; they think most frequently that something is going to happen to them and that they are threatened with some danger; things appear distant to them and acquire some special meaning. They appear to be just in between being in contact with reality and invading that reality with their own projected world. After this they enter the prestuporous phase, in which they undergo a singular set of psychic experiences which have almost a hallucinatory quality. They see themselves as little children; they relive some eventful, usually painful, episodes of childhood and doing this they, like the patient in the dream about the ogre, perceive themselves now as little children and then as distant observers of their childhood. The attacks of respiratory and cardiovascular nature coincide or alternate with these "reminiscences." But only bare facts can be recalled. They cannot work retrospectively through this material because of their emotional shallowness. Like this patient, they have the ideational content before their mind's eye. They recall vaguely their physical discomfort, but they fail to bring forth the charge of affect which they conceal so thoroughly and in such an incomprehensible fashion. Just before the onset of the stupor they find themselves thinking of death; they become inert; they have visions of great masses of water; the feeling of physical tension and mental discomfort disappear; they enter a state of feeling of blissfulness and find themselves in a more or less profound stupor. This regressive process is a gradual one and could be described as a slow dissolution of the ego, the total personality reverting to its original undifferentiated psychologic state. This state of amorphous existence is like the original one in that both physically and psychically the patient's perceptions become diffused, undifferentiated perceptions and presentations, a complete physiologic passivity and indefinite amorphous imagery like endless masses of quietly moving water. In order to enter this state the patient must rid himself of actual and psychologic reality, and this process is marked first by a sense of estrangement from the world which is naturally accompanied by anxiety, and then by perceiving one's own feelings as foreign to one's self, plus a pleasant half-thought, half-feeling of death which is the final step in the process of dissolution of the ego.

Midway between the projection of one's total inner life into the outer world and this new outer (inner) world there is a moment when the subject perceives this inner world as an outer one and, rid as he is of his ego (pleasant feelings of death), he reacts to its demands, which are now coming from without, with the same increase of tension with which he reacted at birth to the impact coming from the outer physical world. The ideation is no more perceived as his own; the affect is withdrawn from the ego, and the sense of danger disappears. The feeling tone of anxiety, being essentially fear, acting as a defensive measure for the ego, becomes biologically unnecessary in the absence of the ego.

The patient under discussion seemed to justify the belief that he had reached a turning point in his analysis, sensing or even courting the possibility of choosing a psychotic outcome. Such a possibility opened itself before him only after he had succeeded, for a moment at least, in regressing to the most primitive form of anxiety, i. e., its physiologic prototype, even in the face of frank imagery of ideation and memories connected with castration. It is probable that he was potentially catatonic.

PEARSON, Philadelphia.

THE INFLUENCE OF PSYCHOLOGIC FACTORS UPON GASTRO-INTESTINAL DISTURBANCES: I. GENERAL PRINCIPLES, OBJECTIVES, AND PRELIMINARY RESULTS. FRANZ ALEXANDER, Psychoanalyt. Quart. **3**:501 (Oct.) 1934.

Alexander points out that most organicists recognize that gastro-intestinal disturbances frequently result from emotional difficulties, but that they do not specify what the emotional difficulties are or how they operate. Psychoanalysts, on the other hand, show a great readiness to interpret somatic phenomena as direct expres-

sions of definite psychologic content. The fact that the organic symptoms are usually the final result of a chain of intermediary organic processes is hardly ever fully taken into account in analytic literature. Thus, an ulcer of the stomach or duodenum is the direct result of a disturbance in motor and secretory functions, which disturbance, however, may be caused by emotional factors. Yet the end-result, the ulcer, cannot be interpreted psychologically because it has no psychologic significance. What can be interpreted as a direct effect of psychologic factors is the hypersecretion or hyposecretion and the change in the motor activity and in the blood supply of the stomach.

The object of Alexander's research has been (1) to establish the affinity of specific emotional factors or conflict situations to specific vegetative systems and to certain specific organic expressions within the same system, (2) to establish more definitely the therapeutic efficiency of the psychoanalytic approach in such cases and (3) to establish criteria for determining which patients need psychoanalysis and which can be handled by specific practical readjustments of their life.

Alexander has found useful a rough preliminary classification which divides the cases of gastro-intestinal disturbances into three groups: (1) gastric cases, including those in which there are minor subjective gastric symptoms such as epigastric distress, nausea, heart burn and belching, and also severe cases of peptic ulcer; (2) cases in which there is one predominant symptom of diarrhea and cases in which the condition is usually diagnosed as mucous or spastic colitis and in which the symptoms consist of painful cramps, evacuations and often alternation of diarrhea and constipation, and (3) cases in which the predominant symptom is chronic constipation. Briefly, the cases of gastro-intestinal disturbances are divided into the gastric, colitis and constipation types. The patients in each group especially those with the gastric and colitis types of disturbance showed a remarkable similarity of manifest emotional attitudes, unconscious conflict situations and predominant central dynamic trends.

Nine cases of the gastric type (six of duodenal and three of gastric neuroses) were studied. In these it was apparent that gastric symptoms often appeared in connection with intense oral-receptive tendencies, the wish to be taken care of and loved, which usually were more or less repressed. In most cases the typical conflict situation can be described as the rejection of strong oral-receptive tendencies on account of their incompatibility with the aspiration of the ego for independence and activity. The conscious attitude of the patients in this group could be best verbalized as follows: "I am efficient, active, productive; or I give to everybody, help people, assume responsibilities, like to have people depend on me, like to be the effective leader and the self-sufficient, active or even aggressive personality." At the same time Alexander found in the unconscious exactly the opposite attitude: an extreme and and violent craving for love and the need for dependence and help. In most of his cases he found these tendencies to be repressed and denied by the patient and associated with violent conflicts.

There is in the unconscious a deep oral regression to the parasitic situation of the infant, which in most cases is incompatible with the attitude and ideals of the adult ego and therefore must necessarily be rejected. Analysis of Alexander's cases shows among the specific reasons for the ego's rejection of these parasitic infantile claims two predominant motives: (1) a narcissistic injury caused by the infantile claims and manifested on the surface in a sense of inferiority and (2) guilt and fear.

Alexander suggests tentatively that repressed oral-receptive and oral-aggressive impulses lead to gastric symptoms and even to peptic ulcer of the stomach or duodenum, in the following way: If the intense wish to receive, to be loved, to depend on others is rejected by the adult ego and consequently cannot find gratification in normal life relations, then only the regressive pathway remains open; the wish to be loved becomes converted into the wish to be fed. Persons who on account of the described conflict-situation have to repress and abnegate their overstrong receptive cravings express them in the tacit physiologic language of the functions of the stomach. Such a stomach behaves all the time as if it were taking

or were about to take in food. Under this permanent chronic stimulation the stomach behaves constantly as it does during digestion. A chronic hypermotility and hypersecretion may be the consequence. The empty stomach is thus constantly exposed to the physiologic stimuli to which, under normal conditions, it is exposed only periodically when it contains or is about to receive food. The symptoms of nervous indigestion, epigastric distress, heart burn and belching probably are the manifestations of this chronic stimulation, which sometimes may even lead to the formation of an ulcer.

Five cases of the colitis type were studied. Superficially they are different from cases of the gastric type. The patients emphasize that they do not receive from others what they should in spite of their own great willingness to help and give and in spite of their generosity and interest in others. Whereas the patients with the gastric type of disturbance in reality are efficient, frequently also helpful and generous, or at least make real efforts to be so, those with the colitis type do only lip-service in this respect. They readily give up work or, if they work they usually do so as a result of external necessity and lack the genuine effort and ambition. In their unconscious, often in their consciousness, Alexander finds the same oral-receptive and acquisitive aggressive tendencies which are so strong in the cases of the gastric type, but both the fear and the sense of inferiority are eliminated, probably because of the symbolic meaning of the physiologic symptom, diarrhea. This has the meaning of restitution for what the patient wishes to take from others and also that of activity and aggression in contrast to passive in-taking. In these cases the lower end of the intestinal tract, the function of which consists mainly in elimination, is mobilized and excited to increased activity. The patient gives anal, or rather, intestinal values as a compensation for oral receptivity and aggressiveness, in order to keep up the balance between the receiving and the eliminating tendencies. In all the cases in female patients the diarrhea means restitution for castrative wishes and also represents masculine activity in contrast to female receptivity.

So far it has not been possible to advance a detailed physiologic theory to explain how the wish for restitution and giving (productivity) and aggressive tendencies are converted into the physiologic changes that are responsible for the symptoms of colitis. It can be assumed that the peristaltic function of the intestines, under the permanent psychic stimulus of the wish to eject and to give, becomes independent of the normal physiologic regulations. Normally the peristaltic functions are periodically regulated by the intestinal content, but in these neurotic cases a psychologic tendency independent of the nutritional process stimulates the peristaltic functions. In all the cases it was possible to reconstruct a connection between the diarrhea and the repressed unconscious tendencies of restitution or aggression.

Enough material on the constipation type has not been collected to make many generalizations permissible. There are some trends which seem to be characteristic. A pessimistic attitude of the patient toward receiving help from others or depending on them seems to prevail. The patient seemingly does not expect anything from anybody. At the same time, there is a more or less conscious, extreme sense of obligation to give, of which the patient tries to rid himself by renouncing all conscious receptive tendencies. "I can not expect anything from anybody and therefore I do not need to give anything. I hold on to what I have." The aversion to all kinds of obligation to give is based on intense castration fears which the patient tries to get rid of by renouncing and denying his oral tendencies. In these cases also there is found an anal-sadistic attitude, the inhibition of which contributes to the anal retention.

Alexander concludes that the gastro-intestinal tract, according to its three major functions of intaking, retaining and eliminating, is especially suitable for the expression of these three elementary tendencies, if their normal expression through the voluntary motor system or through the sexual apparatus is inhibited through inner conflicts. Alexander is convinced that analysis of a person's emotional attitude to his environment in the terms of these three major tendencies, (1) to receive

and take, (2) to retain and (3) to give, will not only prove useful for the understanding of disorders of the gastro-intestinal system but will also be found to have more general significance. These three groups of emotional tendencies seem to be of the most elementary nature, and their recognition makes possible the further analysis of the emotional reactions of the subject to his environment, including sexual relations.

PEARSON, Philadelphia.

THE FEELING OF GUILT. HERMAN NUNBERG, Psychoanalyt. Quart. **3**:589, 1934.

According to Freud there are two kinds of feelings of guilt: (1) social fear and (2) pangs of conscience. The latter—fear of the super-ego—results from the turning of aggression against the ego and appears in the ego as an unconscious need for punishment. Nunberg discusses the question whether a feeling of guilt and a need for punishment are synonymous. The expressions of the feeling of guilt fall into two groups: The aim of the first is reconciliation with the world, of which the striving for love is an example, while the aim of the second group is the ego, namely, the attempt to punish oneself. In both the reaction is to a crime committed psychically or actually. The traces of this crime lead into the Oedipus situation—parricide—and the totem meal, with its subsequent remorse and deification of the father now physically effected through identification by the erection of the super-ego. Earlier than the stage of projection and deification of the father, however, is the mourning rite of ejecting feces on the grave of the beloved deceased. Such behavior is seen in patients who effect a regression to anal eroticism when tormented by feelings of guilt. The catatonic person often claims that the feces are a child to which he has just given birth, and in that way he reconstructs the world which in his imagination he has destroyed. In the melancholic person the inability to offer a gift of feces owing to constipation, increases the severe sense of guilt. Feelings of guilt, therefore, are accompanied by a regression to the anal stage of development in order to eject the orally incorporated object in an anal way and thus weaken the feeling of guilt.

As the feeling of guilt originates in a hostile identification and is undone through restitution, it expresses a relation between taking and giving. It is also connected with the primitive feeling of possession. This has two roots: the instinct to master and the renunciation of an instinct to gratify (retention of feces) in order not to lose love. The adult giving up a possession in order not to lose love acts like the little child. In giving up a part of his possession he renounces the actual mastering instinct, and a lessening of his tendency to aggression results.

The tendency to relieve the feeling of guilt by ejecting the object is associated with the desire to remove the object and to gratify the libido with it. The paranoiac subject achieves this gratification through projection, the religious person through religion, and the normal person through productive accomplishments and the formation of social unions. The neurotic person is disturbed in this striving. The feeling of guilt also coincides with the fear of loneliness. According to Nunberg, the feeling of guilt produces not only tendencies which aim to gratify object libidinal strivings, for the person burdened with guilt suffers and desires suffering. Atonement by punishment seems his only means of reconciliation. In the development of the super-ego the strict demanding and inhibiting father of the outer world is incorporated in the ego and inhibits certain id tendencies and impulses from expression in the outer world. The aggressive tendencies are redirected by the super-ego on the ego, the super-ego behaving as if it wanted to take vengeance over and over on the ego for the act of identification. This appears as a need for punishment. The mechanism of turning of the aggression against the ego does not occur as late as the time of the Oedipus conflict but comes into action as soon as the necessity for self-punishment is present—very early in the pre-oedipal period of development.

This feeling of guilt is a fear of loss of love, and it tries to restitute a lost or about to be lost love relation, while the need for punishment is an aggressive

tendency redirected from an object onto the ego. In other words, ungratified libido is concealed behind the feeling of guilt and aggression is concealed behind the need for punishment.

In hysteria the feeling of guilt is prevalent; in compulsion neurosis the need for punishment is predominant. In melancholia the loss of object libido is added, and the aggression against the ego reaches its climax. In the productive forms of schizophrenia the feeling of guilt takes the form of delusional ideas of the redemption of the world; in the persecutory forms the need for punishment clothes itself in persecutory delusions. The feeling of guilt is an ambivalent formation. In warding off an instinct the tendency is to break it up into libidinal and destructive components. The ego strives to synthesize these and to unite the instincts in a compromise of guilt and punishment. Whether the feeling of guilt or the need for punishment prevails depends on the instinctual constitution and on the degree of instinct fusion or defusion.

PEARSON, Philadelphia.

A NOTE ON "THE MERCHANT OF VENICE." T. A. ROSS, Brit. J. M. Psychol. **14**: 313, 1934.

An analytic view of the play is presented. The author maintains that Shakespeare's chief interest was in Antonio. Evidence is presented to show that Antonio was a "conscious but continent homosexual"; this, however, leaves some confusion as to whether conscious or unconscious is actually indicated. The fading of this character from prominence is accounted for by Shakespeare's acquiescence to censorship. Ross concludes that Shakespeare's attitude toward continent homosexuality was one of respectful admiration.

ALLEN, Philadelphia.

FURTHER STUDIES IN THE RESPIRATION OF PSYCHOTIC PATIENTS. ERICH WITTKOWER, J. Ment. Sc. **80**:692, 1934.

The respiration of psychotic patients was studied by means of a plethysmograph constructed by Golla and Antonovitch. Forty normal controls were used and 302 psychotic patients were tested. Of the normal controls about half were regular breathers and the other half were irregular breathers. Of 1001 patients with schizophrenia, 81 were regular breathers and 20 irregular breathers. Of 101 patients with affective psychosis, 69 were regular and 32 irregular breathers. In a previous study Golla and Golla and Antonovitch (*Brain* **52**:491 [Dec.] 1929) postulated the theory that the visual type of imagery prevailed in regular breathers and the auditory type of imagery in irregular breathers. Wittkower is not able to explain why the regular type of respiration prevails among the schizophrenic patients. He also believes that the prevalance of visual imagery cannot be evaluated in the schizophrenic subject on account of inaccessibility; one must also bear in mind that there is a possibility of a change in the respiratory or psychologic reaction under the influence of a psychosis. In reference to the ventilation of 123 schizophrenic subjects as compared with that of 40 normal controls, the author found that frequently not much difference exists. Often the respiration of schizophrenic persons is abnormally shallow and frequent. The shallowness of respiration is mostly compensated or overcompensated by frequency of respiration.

KASANIN, Howard, R. I.

BASAL METABOLIC RATE IN MENTAL DISEASE. A. ZECKEL and S. D. POSTHUMUS, Schweiz. Arch. f. Neurol. u. Psychiat. **23**:271, 1934.

Contradictory results in reported studies of the basal metabolic rate in cases of mental disease are attributed by Zeckel and Posthumus to a lack of uniformity both in the classification of cases and in the technic and choice of method in making the tests. The group of thirty-six patients studied included thirteen patients with manic-depressive psychosis, four with neurosis, fifteen with schizophrenia and four with dementia epileptica. In all the manic patients the basal

metabolic rate was on the plus side, although in none was the rate in excess of the normal range. The low readings observed in depressed patients seemed to be related to psychomotor retardation, since the eight who showed such retardation gave readings ranging from —24.5 to —6.4 per cent with an average of —14.8 per cent, whereas the rate was slightly elevated in one patient with agitated depression. Normal rates were obtained in all the patients with neurosis. The tendency to low rates generally exhibited by schizophrenic and epileptic patients seemed to be directly proportional to the degree of apathy. The average reading of —10.4 per cent for six patients with hebephrenia was slightly lower than that for the entire schizophrenic group. According to the authors, Fischer's conclusion, based on determinations of the specific dynamic energy of proteins, that schizophrenia is due to endocrine dysfunction is supported neither by theoretic considerations nor by the results of their studies.

DANIELS, Denver.

THE DESCENDANTS OF PERSONS WITH ALCOHOLISM. L. E. GABRIEL, Arch. f. Psychiat. **102**:506 (Nov.) 1934.

Gabriel reports an investigation of the children of a large number of persons suffering from alcoholism with special reference to the occurrence of psychopathic and psychotic traits. The material consists of 728 patients with alcoholism; 223 were committed to a hospital for persons with mental disease and 505 to an institution for inebriates; 1,094 children were studied. The family histories of the patients themselves showed a marked hereditary taint in the ascendants. The most important feature in this regard was the fact that alcoholism was particularly frequent in the ascendants of patients who showed alcoholic psychoses or criminal tendencies. In the 728 cases there were 1,347 pregnancies, of which 1,094 terminated in the birth of living children. Of these children, 17 per cent born of alcoholic parents in hospitals and 13 per cent of the others died, the highest death rate being in children between 1 and 10 years of age. There was a large percentage of mental aberrations in these children, including alcoholism, criminality, mental diseases of various types, suicidal attempts, etc. The author comes to the conclusion that a comparison between the abnormal persons among the ascendants, the patients themselves and the children points to an increase in abnormal features already present rather than to an occurrence of new psychic difficulties.

MALAMUD, Iowa City.

ALLOCATION OF GUILT (TO OTHER PERSON OR TO SELF) BY PATIENT, AND ITS SIGNIFICANCE FOR PROGNOSIS OF INVOLUTIONAL PSYCHOSES. WERNER SCHEID, Ztschr. f. d. ges. Neurol. u. Psychiat. **150**:528 (July) 1934.

According to the sources of a feeling of guilt, four distinctions may be made: (1) primary self-blame; (2) blame of the outside world primarily; (3) blame of the outside world secondarily and (4) secondary self-blame. The first type is most frequently encountered in cases of cyclothymic depression; the second is associated especially with schizophrenic processes; the third arises from a blame which is originally placed on the self and then projected onto the outside world, and the fourth, which is the antithesis of the third, is a blame which starts primarily in the outside world and then turns inward so that the self alone assumes the blame. There are usually mixtures of several forms and transitions of one form to the others.

Fourteen clinical cases are reported to illustrate the various directions which the feeling of guilt takes. Blame which is primarily thrust on the environment and which occurs with the onset of a psychosis is probably indicative of an unfavorable prognosis. The blame which has been secondarily evolved to become a blame on outside forces permits a better prognosis if all relationships between the blame of the self and the external world have disappeared.

MICHAELS, Boston.

AUTOPSY OBSERVATIONS IN CASES OF SUDDEN AND OBSCURE DEATHS AMONG PSYCHOTIC PATIENTS. KARL NEUBÜRGER, Ztschr. f. d. ges. Neurol. u. Psychiat. **150**:670 (Aug.) 1934.

The observations at autopsy in fourteen cases of sudden and unexpected death are described. These included acute dilatation of the stomach and bleeding from the intestines, lungs and heart which were unrecognized clinically. Persons with epilepsy who die suddenly show circulatory changes in the cerebral vessels with recent involvement of the ganglion cells and serious damage of the muscles of the heart. Sudden death in cases of dementia paralytica is unusual; that occurring in cases of Pick's and Alzheimer's disease is due to changes in the central nervous system which cannot be demonstrated histopathologically. Juvenile patients with encephalitis who die suddenly may show apoplexy of the brain or heart.

MICHAELS, Boston.

VISUAL HALLUCINATIONS AND EIDETIC PHENOMENA IN DELIRIUM TREMENS. EUGEN POPOW, Ztschr. f. d. ges. Neurol. u. Psychiat. **151**:327 (Oct.) 1934.

In thirteen (70 per cent) of eighteen patients with delirium tremens eidetic phenomena of various degrees were found forty-eight hours after the cessation of visual hallucinations. This finding tends to corroborate the speculation that eidetic phenomena are intermediate between a normal state and a hallucinatory state.

MICHAELS, Boston.

Diseases of the Brain

VASCULAR ACCIDENT AND HEMIPLEGIA IN A PATIENT WITH SICKLE CELL ANEMIA. JAY M. ARENA, Am. J. Dis. Child. **49**:722 (March) 1935.

Vascular accidents may occur in sickle cell anemia; in the case reported the patient suffered from a cerebral thrombosis. Blood was found in the spinal fluid.

WAGGONER, Ann Arbor, Mich.

CHANGES IN THE PSYCHOLOGICAL FUNCTIONS IN PARESIS: I. RETENTION AND RECALL. CAREY LANDIS and JOSEPH RECHETNICK, Psychiatric Quart. **8**:693 (Oct.) 1934.

In examining the case histories of a hundred patients suffering from dementia paralytica, Landis and Rechetnick find that there was impairment of retention and immediate recall in ninety cases, of insight and judgment in eighty-five cases and of counting and calculation in eighty cases. These factors are relatively independent of the personal judgment of the examiners and were found shortly after the admission of the patients. An examination of the protocols of the same patients after discharge showed that retention and recall had improved in 92 per cent of the patients discharged as improved, but in only 16 per cent of those discharged as unimproved. Counting and calculation had improved in 60 per cent of the patients discharged as improved and in only 43 per cent of those discharged as unimproved. No such correlations were noted in other functions, such as comprehension, writing, affect, judgment, etc. The authors are inclined to believe, therefore, that improvement in retention and immediate recall are good gages of general psychic improvement. They designate the amelioration of these factors as "the most important apparent psychological change occurring during the course of recovery following treatment."

DAVIDSON, Newark, N. J.

CHANGES IN PSYCHOLOGICAL FUNCTIONS IN PARESIS: MOTOR COORDINATION, INTELLIGENCE, AND REACTION TIME. P. H. DUBOIS, L. L. MAYS and CARNEY LANDIS, Psychiatric Quart. **8**:699 (Oct.) 1934.

The fact that patients with dementia paralytica in whom some destruction of brain tissue has probably taken place are able to resume a place in society suggests

that there has been some major reformulation of psychologic function after treatment. To determine what changes, if any, occurred in motor coordination, intelligence and reaction time, the authors subjected thirty-five patients to a series of psychologic tests. The average score on the army alpha intelligence test was raised 20 points between the time of admission and the time of retesting after treatment. The average time required for four trips through a standard maze with a hand stylus was 44.4 seconds before and 32.1 seconds after treatment. Reaction speed was measured by a tapping test, and the average number of taps in a thirty second period was 348.8 before and 367 after treatment. Although some of the improvement may be due to the coaching effect of repetition, much of it is not, and the authors believe that fever treatment causes a real improvement in actual mental ability.

DAVIDSON, Newark, N. J.

GENEALOGIC, CLINICAL, AND HISTOPATHOLOGIC STUDIES ON THE INFANTILE FORM OF AMAUROTIC FAMILY IDIOCY. IVAN BERTRAND and LUDO VAN BOGAERT, Encéphale **29**:505 (Sept.-Oct.) 1934.

The racial factor plays an undeniable rôle in the appearance of infantile amaurotic idiocy. Six of the cases have been in families in which both parents were Jewish; only one occurred in a mixed family. Without denying that the condition may appear in non-Jewish stock, Bertrand and van Bogaert consider this so rare as to warrant an unusually close inquiry into family genealogy. In two families the stock was Russian Oriental; the patients manifested the classic retinal picture. Consanguinity of parents was certain in only one family. In every case there was a history of tuberculosis, epilepsy and disturbances of the endocrine system in at least one parental stock. Among collaterals were found numerous neuropsychiatric syndromes consisting of degenerative conditions, moral disturbances, dementia praecox, hallucinatory psychoses and melancholias. The authors think that it cannot be denied that the families presented a highly neuropathic picture.

Amaurotic idiocy is transmitted apparently as a recessive character.

The authors add tonic reflex manifestations to the clinical picture described by Sachs. In the cortex occur granular inclusions and hypertrophy of the prolongation of the neuroglia. The degeneration, or arrest of development, of myelin stressed by Schaffer is borne out in these studies. The greatest alteration occurs in the temporo-occipital region. The myelinic degeneration seems to be related to the myelinic maturity of the particular areas of the brain.

ANDERSON, Los Angeles.

POSTENCEPHALITIC OCULOGYRIC SPASM. E. ENGERTH, Deutsche Ztschr. f. Nervenh. **134**:191 (July) 1934.

Engerth reports a case of postencephalitic oculogyric spasm which was accompanied by peculiar manifestations. The patient, a boy aged 17, had had an attack of encephalitis at the age of 10. For several years following this he appeared to be well except that he was more irritable and not up to his usual standard of school work. At the age of 14 oculogyric attacks developed. Immediately before and during such attacks, which lasted a few hours, there was a state of anxiety with obsessive ideas. The patient had a strong desire to run away from home. This, he thought, was the only way to bring about a permanent cure. At the same time he brooded over the fact that in this state he was unable to move. During the height of an attack he entertained ideas of suicide. Sleep terminated an attack. On awakening from such a sleep the patient felt perfectly well but was euphoric and had at times an irresistible desire to run away. Memory of his behavior during such a period was rather vague.

BERNIS, Rochester, N. Y.

CIRCUMSCRIBED DAMAGE TO THE BRAIN WITH DISTURBANCES IN VARIOUS SPHERES OF ACTIVITY. EVA ROTHMANN, Schweiz. Arch. f. Neurol. u. Psychiat. **33**:35 and 228, 1934.

Rothmann reports a case from Goldstein's clinic in support of the latter's contention that amnesic aphasia is only one expression of a disturbance in the fundamental relations of a person to his environment, more specifically, a disturbance in the "categorical relation." A woman, aged 48, who held a responsible position as a bookkeeper and stenographer, had discharged her duties in a satisfactory manner up to the time of a cerebral vascular accident which occasioned her admission to the hospital. Though suffering from chronic heart disease, she remained for several months in sufficiently good condition to permit extensive psychologic study. Aside from agraphia, which later regressed, the primary motor and sensory functions were spared. The patient showed a paranoid tendency for a time and continued to be unduly sensitive to trivial irritations, but otherwise seemed mentally intact. Although spontaneous speech was limited, the patient had little difficulty in speaking so long as the conversation was confined to commonplace things or to matters touching her directly. A question calling for some reflection, on the other hand, either left her mute or was answered in a hesitating, faulty manner. Discussions involving action and concrete situations were much easier for her than were discussions of abstract situations. Enumeration of the capitals of Europe proved difficult, yet during a lively conversation relative to a trip she promptly named the principal cities of the various countries mentioned. Similarly, although it was difficult for her to name the pieces of furniture commonly found in a bedchamber, she had no trouble in describing the furnishings of her own home.

The patient's performance in sorting objects and colors gave the observers the clearest insight into the nature of her difficulty. Asked to arrange a number of articles, she at once grouped them according to their respective uses but was more or less unable to arrange them according to size, shape or color, even after such arrangements had been suggested to her. To her, objects seemed to have no meaning other than that of their ordinary uses in a concrete situation. For instance, when the Holmgren test was carried out she was given a skein of bright green yarn and asked to select all other skeins of the same color. She picked up a skein of the identical or of a closely similar shade and then stopped. When urged to continue, she selected a few darker shades, but each successive skein she chose was closely similar to the one previously selected. When the last skein selected was removed by the observer, she became perplexed. The patient also chose some skeins of a different color, but it was apparent that in doing this she was thinking of a color scheme for a dress. That she was not color blind was evidenced by her ability to distinguish slight differences in the various shades of the same color. These tests demonstrated the patient's inability to regard objects as representatives of a category and to classify them with other objects belonging to the same category.

So long as the matter pertained to her directly or to her immediate environment, the patient understood spoken sentences of rather complicated structure even though she failed to grasp the meaning of simple stories read to her from a primer. She read aloud well, but it was evident that her understanding of the matter was limited. With occasional prompting in the beginning, she counted and recited the alphabet well, but her performance in this respect was largely mechanical, as evidenced by the fact that in reciting the odd numbers she whispered the intervening even numbers. Similarly, her spelling was good only so long as she was permitted to proceed quickly without pausing between the single letters.

Though well oriented in her surroundings, the patient had difficulty when forced to consider position and direction in "objective space." Regardless of the position in which a pencil was held, for instance, the pointed end was always, for her, the lower end. Her errors in performing such acts as touching the left ear with the right hand were attributed not to an apraxia, but rather to difficulty in giving due consideration to the requirements of the problem. Apart from multiplication and

addition of small numbers, the patient did poorly with problems in arithmetic. The addition and multiplication signs had no meaning for her unless appropriately placed between numbers.

The promptness with which the patient named objects and parts of the body appeared, at first glance, rather unusual in a case of amnesic aphasia, but further tests with colors seemed to confirm the impression that the conceptual value of words was lost. The possible explanations for the varying degree of difficulty in the recalling of words (*Wortfindung*) in different cases of amnesic aphasia is discussed. Aside from the early agraphia, writing was disturbed in much the same manner as was speech.

The sudden onset of symptoms seemed to argue for a circumscribed lesion as opposed to diffuse cerebral changes. Goldstein's "peripheral cortex," that is, the central gyri and primary speech centers, seemed to be intact, thus placing the lesion in the "central cortex." As the absence of apraxia, severe akinesia and gnostic disturbances rendered frontal or parietal involvement unlikely, the lesion was thought to be located either in the left insula or in contiguous areas; this view was supported by the presence of a central aphasia. Because of the early agraphia the existence of an additional small lesion in the posterior part of the left second frontal convolution was postulated.

DANIELS, Denver.

OBSERVATIONS AT AUTOPSY IN A CASE OF FOCAL LESIONS OF THE BRAIN WITH DISTURBANCES IN VARIOUS SPHERES OF ACTIVITY. K. GOLDSTEIN, Schweiz. Arch. f. Neurol. u. Psychiat. **33**:242, 1934.

Goldstein's description of the observations at autopsy confirm, to a great extent, the conclusions based on a clinical study of the same case as reported by Rothmann. Two larger and three smaller areas of softening, limited largely to the cortex, were found. The larger areas were located in the central portion of the left insula and in the anterior portion of the left temporal lobe, respectively; Wernicke's area was intact. A small area of softening was seen in the junction of the left second and third frontal convolutions with the precentral gyrus; a still smaller one was noted in the anterior extremity of the left inferior parietal gyrus. A small and superficial lesion was also found in the right frontal lobe. The normal appearance of numerous microscopic sections from other areas and the absence of symptoms generally encountered in cases of diffuse cerebral disease seemed to justify the conclusion that the symptoms could be ascribed to the focal lesions. Though inclined to attach some importance to the lesion in the temporal lobe, Goldstein relies chiefly on the insular involvement to account for the fundamental disturbance of which the "central aphasia" was the principal manifestation.

DANIELS, Denver.

CEREBRAL TUMOR WITH FEW SYMPTOMS. ROBERT BING, Schweiz. Arch. f. Neurol. u. Psychiat. **33**:219, 1934.

After briefly considering the reasons for the paucity of signs and symptoms in certain cases of intracranial tumor, Bing reports a case of dural endothelioma in a girl, aged 6 years, who had been suffering with headache for one year. Although there were considerable papilledema, pressure atrophy of the skull and engorgement of the cranial veins, neurologic examination revealed no abnormalities aside from absence of the abdominal reflexes on the left side and a slight ataxia of the upper extremities. The headaches soon disappeared, but shortly after the child returned to school, five months later, a cranial defect (*auto-trephine*) was discovered in the right parietal region. A year after the first examination swelling of the disks was no longer evident, and the left abdominal reflexes had reappeared, although the tendon reflexes were slightly exaggerated in the left leg and the left arm had become slightly more ataxic than the right. The child remained bright and active, but her head increased in size, and the cranial defect gradually became larger. During the fifth year following the first examination the headaches

recurred, slight swelling of the optic disks was noted, and the abdominal reflexes again disappeared on the left side. Though the patient remained under observation until death, which occurred six years after the first appearance of symptoms, no further objective signs were elicited. At autopsy the tumor was found to be 9 cm. in diameter; it was attached to the dura in the right parietal region and extended deeply into the substance of the hemisphere, which was greatly distorted though not actually invaded by the neoplastic tissue.

DANIELS, Denver.

DISEASES OF THE GROUP OF PSEUDOSCLEROSIS (WILSON) IN YOUNG CHILDREN. W. J. C. VERHAART, Ztschr. f. d. ges. Neurol. u. Psychiat. **150**:493 (July) 1934.

Verhaart reports three cases of pseudosclerosis in Chinese children—a boy aged 4 years, a girl aged 8 months, and a girl aged 7 months. All showed a tendency to extension of the extremities and of the trunk with pathologic reflexes in both feet. There were accompanying symptoms of involvement of the brain, dulness, strabismus, high fever and vomiting. Histopathologically, in all three cases there were the end-results of a severe phagocytosis in the brain and complete degeneration of the tissues into fat. There were a large number of granular cells and little evidence of activity on the part of the fixed glia cells in the removal of the fat. The etiology is unknown; in the absence of inflammatory reactions a toxic agent is postulated.

MICHAELS, Boston.

A CASE OF POLYCYSTIC EPENDYMOMA OF THE CEREBELLUM. O. FOERSTER and O. GAGEL, Ztschr. f. d. ges. Neurol. u. Psychiat. **150**:515 (July) 1934.

Only two cases of polycystic ependymoma of the cerebellum have previously been reported in the literature (Herzog, 1899, and Henschen, 1907). The symptoms presented by the patient, a woman aged 20, were understandable in the light of the location and extension of the tumor. The fourth, fifth, sixth, seventh and eighth cranial nerves on the left side were paralyzed, and there was a definite cerebellar syndrome with a tendency to fall to the left. The cyst occupied the left cerebellar lobe and a considerable portion of the restiform body, the cerebellar brachium to the pons and the brachium conjunctivum and involved the aforementioned cranial nerves. Histopathologic study raised the interesting question as to the nature of the cyst, i. e., whether the origin was from the choroid plexus or from the ependyma.

MICHAELS, Boston.

Peripheral and Cranial Nerves

THE INFLUENCE OF GLYCIN ON CREATINURIA IN PERIPHERAL NEURITIS. M. J. C. ALLINSON, H. H. HENSTELL and H. E. HIMWICH, Am. J. M. Sc. **188**:560 (Oct.) 1934.

A case of toxic peripheral neuritis with muscular atrophy was studied. Amino-acetic acid was given at three different periods; when the administration of amino-acetic acid was discontinued the excretion of creatine gradually diminished to zero. Although there was improvement in the neurologic symptoms, this could not be correlated definitely with the short period during which amino-acetic acid was fed. Edestin or glutamic acid caused no changes in the output of creatine. In contrast with the effect in other cases of secondary muscular atrophy, but like that in those of progressive muscular dystrophy and myasthenia gravis, the ingestion of amino-acetic acid markedly increased the creatinuria.

MICHAELS, Boston.

THE RESULTS OF PERIPHERAL ANASTOMOSES BETWEEN THE FORE AND HIND LIMB NERVES OF ALBINO RATS. DONALD H. BARRON, J. Comp. Neurol. **59**:301 (April) 1934.

The purpose of these experiments was to determine more clearly the rôle of the sensory axons in the redistributed nerves in the "relearning" process which

follows anastomoses of the nerves. Three separate series of anastomoses were carried out on the nerves, one type in each animal. In the first series the proximal cut ends of the median and ulnar nerves were united to the distal portion of the femoral nerve; in the second, the median and ulnar nerves were joined with the peripheral portion of the sciatic nerve; in the third, the posterior tibial nerve was joined to the peripheral portions of the medial and ulnar nerves. Young male albino rats were used. After the operations the animals were examined at intervals to determine the progress of regeneration of the nerves and the state of the muscle groups affected. The regenerated nerves were stimulated in various ways to determine whether they had reached the new muscle group. Thirty-three successful anastomoses were obtained in thirty-seven rats. Of these, eighteen showed natural contractions in the abnormally innervated muscles. Eight showed strict association of movement between test and control limbs. The regenerated axons of the crossed nerves, the median, ulnar and posterior tibial nerves, were all of a uniformly small diameter. The size of the axons originally composing the nerve trunk did not influence the diameters of the regenerated axons. The amount of independent movement attained by the abnormally innervated muscles is in direct proportion to the cross-sectional area of the nerve tissue entering them. The interesting conclusion is reached that the appearance of the associated movements which follow nerve crossing can be avoided by a crossing in which the regenerated nerve has a large proportion of sensory axons.

ADDISON, Philadelphia.

FURTHER OBSERVATIONS UPON ABNORMAL GROWTH RESPONSE OF SPINAL NERVES IN AMBLYSTOMA EMBRYOS. S. R. DETWILER and R. H. VAN DYKE, J. Exper. Zoöl. **69**:137 (Oct.) 1934.

To determine if one type of grafted structure exerts a greater directional influence than another on the convergence of outgrowing spinal nerves toward the foreign implant, 240 operations were carried out involving 12 different types of ocular and nasal placode grafts to the region of the anterior limb bud of Amblystoma embryos. Fifty-five of the 124 positive "takes" were studied by serial section after fixation in von Rath's fluid. It was found that spinal nerves deviated from the normal pathways to converge on the foreign structure but that the penetration of the graft by the outgrowing nerves was not an essential factor influencing the convergence. The similarity in the growth response toward different types of grafted end-structures (limb, eye and nasal placode) suggested that the influence of these end-structures was similar in all cases and was probably associated with forces resulting from proliferation.

WYMAN, Boston.

ANGIOSCOTOMETRY IN CASES OF RETROBULBAR NEURITIS. A. MAGITOT and DESVIGNES, Ann. d'ocul. **171**:53 (Jan.) 1934.

Angioscotometry, as described by Evans in 1926, is the mapping of scotomas extending from the blindspot of Mariotte and the projection of vascular retinal shadows on a chart. After describing the necessary apparatus and the technic to be followed in order to perform angioscotometry, Magitot and Desvignes report a case of retrobulbar neuritis with a central scotoma in a young woman. At the end of fifteen days the scotoma disappeared, but angioscotometry showed an enlargement of the blind spot of Mariotte and a deficiency of the lower vascular shadows, with conservation and widening of the upper vascular shadows. After complete recovery, the blind spot of Mariotte and the vascular shadows were normal.

BERENS, New York.

PROGRESSIVE FACIAL HEMIATROPHY. D. LAZARESCU and E. LAZARESCU, Ann. d'ocul. **171**:1004 (Dec.) 1934.

D. and E. Lazarescu report a case of progressive hemiatrophy of the right side of the face. The patient, a man aged 76, had had the trouble since infancy; it

had followed injury to the head. Electrical reaction showed hyperexcitability of the right side of the face without the reaction of degeneration.

BERENS, New York.

CONTRIBUTION TO THE PATHOGENESIS OF FACIAL HEMIATROPHY. N. IONESCU-SISESTI, J. belge de neurol. et de psychiat. **34**:705 (Dec.) 1934.

Ionescu-Sisesti emphasizes that there are different types of facial hemiatrophy due to varied causes: The first type, congenital facial hemiatrophy is usually part of the picture of a more diffuse involvement of the nervous system due to infection or intoxication by a virus during gestation. The facial hemiatrophy may be the only residual of an obstetric traumatic lesion to the brain. Supranuclear lesions in early life may result in arrest of development of the muscles on the paralyzed side. There are many recorded cases of the second type, sympathetic facial hemiatrophy. The reported cases point to the probability that both irritative and paralytic lesions of the peripheral sympathetic pathways may cause facial hemiatrophy. The author states that sympathetic facial hemiatrophy due to involvement of the spinal cord is possible. He points out, however, that in all cases of syringomyelia with facial hemiatrophy the process extended high enough to involve the trigeminal pathways. The third type considered is facial hemiatrophy due to lesions of the trigeminal nerve. The author reports four cases of syringobulbia with facial hemiatrophy. In all these cases there was definite evidence of involvement of the trigeminal nerve. He correlates this hemiatrophy with involvement of the descending root of the fifth nerve in the region of the substantia gelatinosa of Rolando. He also refers to reported cases of hemiatrophy of the face associated with lesions of the peripheral fifth nerve. The intensity of the hemiatrophy seems to be proportional to the involvement of the trigeminal nerve, and the distribution of the facial atrophy seems related to the zones of diminished sensibility in the distribution of the trigeminal nerve. While the atrophy in peripheral lesions may be attributed to concomitant implication of the sympathetic fibers which are closely related to the fifth nerve, it does not explain cases that follow central conditions of the trigeminal pathways. The author ascribes these cases to involvement of parasympathetic neural components. The fourth type is facial hemiatrophy secondary to involvement of the motor nuclei of the brain stem. The author reports the case of a patient, aged 19, who was being treated for epiphora on the left side and incomplete closure of the left eye. These two symptoms were noted for the first time at the age of 3 or 4 years following "meningitis." Soon after this infection facial hemiatrophy on the left side began to develop. On examination the patient showed facial hemiatrophy, with definite atrophy of the muscles with sparing of the subcutaneous connective and fatty tissues which are involved in the usual cases of facial hemiatrophy. No vasomotor, secretory or sensory changes were found. The bones of the left side of the face were definitely less massive than those on the right. The excessive lacrimation was considered to be due to partial stenosis of the lacrimonasal canal, and the failure to close the left eye was a residual of a previous facial paralysis. The author considers the facial hemiatrophy in this case to be a sequel to involvement of the nuclei of the motor fifth nerve and to a lesser extent of the motor seventh nerve during the course of some infectious disease of the brain stem during childhood.

SAVITSKY, New York.

SYMPTOMATIC ZONA: ITS DIAGNOSTIC VALUE. H. PROBY, Rev. d'oto-neuro-opht. **12**:328 (May) 1934.

Proby maintains that the symptomatic zona is not the expression of the excitation of the ganglion by an ordinary irritative process but is the localization of the zonal disease in a given ganglionic area, the localization being facilitated by a preceding attack on this ganglion by a morbid process that diminishes its resistance. The practical bearing of the discussion is that the nervous area, in

revealing its involvement by a cutaneous eruption, permits, for example, the determination of the existence and seat of a pleuritis, a neoplasm, a medullary compression or syphilis of the central nervous system. The ideas expressed as to the causes of zona are interesting. Disturbances of humoral equilibrium and allergy are in the front rank. These disturbances, which remain general in other conditions, will be localized only at a point of least resistance created by a lesion of a nerve trunk or its branches without the lesion of the ganglion being necessarily primitive or even necessary. The function of the skin is based first of all on the hydrogen ion concentration, the p_H of the tissues. If this concentration varies, the phenomena of osmosis are rendered more or less easy, the electric charge of the particles of the medium is changed, and the biologic phenomena of the tissues (particularly the colloids, ferments and ultravirus) react in the normal and in the pathologic state. The acid-base equilibrium of the skin varies with the region. The acid reaction of the skin prevents the development of microbes. Even the staphylococcus and the mycetes, which are little sensible to acids, cannot multiply when the p_H equals 5. The normal skin is more acid than the blood, and an increase of concentration of hydrogen ions causes a slowing of oxidation in the tissues and a retention of acid products, while increase of hydroxyl ions has a contrary effect. The height of the lesions that follow the nerve fibers depends on the variation of the oxidation-reduction potential. Nerve cells are rich in oxidases, and their minimum potential of reduction is altered by the ultravirus. In short, neurotropism obeys the general laws of chemotaxis.

DENNIS, San Diego, Calif.

LESSONS LEARNED FROM THE PRACTICE OF ALCOHOLIZATION OF THE GASSERIAN GANGLION. T. ALAJOUANINE and R. THUREL, Rev. d'oto-neuro-opht. **12**:739 (Dec.) 1934.

Anesthesia, both superficial and deep, of one side of the face is the same after alcoholization as after retrogasserian neurotomy. Aside from the therapeutic effects of alcoholization, other results of the procedure are discussed: disturbances of the paratrigeminal sympathetic nerves, which are constant, and accidental injury to neighboring nerves. Damage to the sympathetic nerves produces a syndrome of Claude Bernard and Horner, hypotonia of the face and modification of the circulation and of nutrition of the tissues, which has an important bearing on the genesis of neuroparalytic keratitis and favors the development of herpetic infection. The syndrome always occurs under these conditions, which proves that the ocular sympathetic system is represented in the gasserian ganglion. In addition to sympathetic fibers from the carotid plexus, the gasserian ganglion receives fibers also from the bulbar sympathetic centers, located near the sensory nuclei of the trigeminus nerve. The coexistence of a homolateral corneal anesthesia differentiates the gasserian and bulbar syndromes of Claude Bernard and Horner from the cervicomedullary type (which is accompanied by corneal hyperesthesia), and from the subthalamic syndrome of Claude Bernard and Horner, which is associated with corneal anesthesia of the opposite side. The facial hypotonia is not caused by paresis of the facial nerve but results from destruction either of the sensory root or of the sympathetic nerves of the face. Neuroparalytic keratitis frequently occurs unless precautions are taken. The origin of this condition is usually supposed to be the result of the corneal anesthesia, but the authors incriminate rather the herpetic infection, which finds a favorable site in patients who have undergone alcoholization of the ganglion or retrogasserian neurotomy. This depends on the damage sustained by the sympathetic elements in the gasserian ganglion. Early neuroparalytic keratitis may be prevented by protecting the eye immediately after the operation with a special device for two weeks, and then wearing automobile goggles. If keratitis develops, blepharorrhaphy is indicated.

Herpetic infection is a frequent complication. Damage to the neighboring cranial nerves is caused by injecting the alcohol beyond the ganglion into the subarachnoid space. This accident may be prevented by injecting slowly; when

anesthesia appears in the territory of the ophthalmic division it is dangerous to advance the needle farther. The signs of the occurrence of this accident are the immediate experience of general malaise and vertigo, accompanied by nausea, vomiting and nystagmus, peripheral facial paralysis and paralysis of the external rectus muscle. These complications are of short duration. In three patients who suffered this accident the direction of the nystagmus varied according to the side into which the injection was made; in one patient in whom the injection was made on the right side the nystagmus was clockwise; in the other two patients in whom the injection was made into the left side the nystagmus was counterclockwise. Warning against using absolute alcohol is given.

DENNIS, San Diego, Calif.

Vegetative and Endocrine Systems

THE EXOPHTHALMOS OF GRAVES' DISEASE: ITS EXPERIMENTAL PRODUCTION AND SIGNIFICANCE. DAVID MARINE and S. H. ROSEN, Am. J. M. Sc. **188**:565 (Oct.) 1934.

Chronic and progressive exophthalmos can be produced by injections of extracts of the pituitary gland into immature ducks and guinea-pigs and by injections of cyanide into rabbits maintained on a diet of alfalfa hay and oats. Since the most important condition associated with exophthalmos is goiter, thyroidectomy was performed in rabbits, after which the exophthalmos was more easily produced, showing that the thyroid hormone was not the cause. When a potent preparation of the thyrotropic factor of the anterior lobe of the pituitary gland was injected into thyroidectomized rabbits, exophthalmos developed. This indicates that there is a delicate balance between the need for thyroxine and the thyrotropic hormone of the anterior lobe of the pituitary gland. Administration of iodine and desiccated thyroid is the only medical treatment of benefit. The most hopeful means of controlling the exophthalmos in exophthalmic goiter appears to be by prevention of goiter in general.

MICHAELS, Boston.

INSULOGENIC STIMULATION OF SEXUAL DEVELOPMENT. G. A. WILLIAMS and R. L. WILLIAMS, J. A. M. A. **104**:1208 (April 6) 1935.

G. A. Williams and R. L. Williams point out that the administration of insulin to a poorly developed nondiabetic girl 8½ years of age resulted in striking acceleration of body growth and sexual development. This was manifested by increase in height and weight, activity of the mammary glands, ovaries and uterus, assumption of the adult type of fat distribution and a growth of fine body hair. Discontinuance of insulinization was followed by prompt regression of secondary sexual phenomena. Body growth continued, but at a less rapid rate. Resumption of the treatment after a lapse of ten months resulted in prompt reappearance of the sexual phenomena, which regressed as soon as insulin was again omitted.

EDITOR'S ABSTRACT.

COLOR CHANGES IN THE CATFISH AMEIURUS IN RELATION TO NEUROHUMORS. G. H. PARKER, J. Exper. Zoöl. **69**:199 (Nov.) 1934.

Observations on the changes in color of normal, blinded and hypophysectomized common catfish (Ameiurus nebulosus), as well as on the reactions of the denervated caudal fin in such animals to changes of light and injections of blood from experimental subjects in various stages of light adaptation, led to the conclusion that the dispersion of the pigment granules of the melanophores (causing darkening) was effected by two neurohumors: one from the pituitary gland carried by the blood and lymph, weak in action, and a second from the dispersing nerve fibers carried probably from cell to cell, vigorous in action. It was also concluded that the nerve humor was insoluble in blood and that paling may be due to a concentration neurohumor, also insoluble in blood.

WYMAN, Boston.

PINEALECTOMY IN RATS, WITH A CRITICAL SURVEY OF THE LITERATURE. DOROTHY H. ANDERSEN and ABNER WOLF, J. Physiol. **81**:49 (March 29) 1934.

A survey of the results of extirpation of the pineal gland shows that about half of the authors obtained premature development of the sex organs—more often in the male than in the female—frequently accompanied by increased body growth, while the remaining workers obtained negative results. Andersen and Wolf have attempted to settle the problem by eliminating the errors they perceived in the work of their predecessors. By using very young rats, standardizing the breed, diet and age at death, eliminating rats in which a fragment of pineal gland remained and grouping the uninfected rats apart from those having incidental infections they were able to obtain groups of pinealectomized rats, controls that had been operated on and normal controls of both sexes, which they believed to be comparable. They conclude from their observations that complete removal of the pineal gland of the rat between the ages of 1 and 3 days does not influence the rate of growth, age at which puberty occurs, or weight of the pituitary, thyroid, adrenal or thymus glands in either sex; it does not affect the weight of the testes in the male or the occurrence of normal estrous cycles in the female.

ALPERS, Philadelphia.

THE OXYTOCIC PROPERTY OF THE BLOOD OF THE COW. G. H. BELL and S. MORRIS, J. Physiol. **81**:63 (March 29) 1934.

That there is an increase of an oxytocic substance, probably a hormone of the posterior lobe of the pituitary gland, in the blood just before parturition is established. This substance usually disappears six hours after parturition. Bell and Morris studied the effects of extracts of blood from the cow on an excised guinea-pig uterus and demonstrated that measurable quantities appeared in the blood about one week ante partum in the cow and two to three weeks ante partum in the heifer.

The oxytocic property increased up to the time of parturition. The substance was absent from seven hours to eight days post partum. The amount of oxytocic substance in the blood increased after intramuscular injection of extract of pituitary and was labile in the same fashion as the oxytocic property of the blood from parturient cows. The substance disappeared if the alkalized blood extract was allowed to stand at room temperature for a few hours.

PALMER, Philadelphia.

THE CHEMICAL TRANSMISSION OF SECRETORY IMPULSES TO THE SWEAT GLANDS OF THE CAT. H. H. DALE and W. FELDBERG, J. Physiol. **82**:121 (Aug. 24) 1934.

It was suggested in 1933 by Dale that the anomalous responses of the sweat glands of the cat to drugs probably indicates that their secretory nerve fibers, though originating in ganglia of the sympathetic chain, are cholinergic, and thus present an exception to the general rule that postganglionic sympathetic fibers are epinephrinergic. The experiments described in this paper were undertaken to test this suggestion.

The object of the experiments was to collect the venous blood or perfusion fluid from the hairless pads of the cat's foot and to discover whether stimulation of the sympathetic nerves, applied in such a way as to evoke a secretion of sweat, caused the appearance of acetylcholine in the venous effluent. Dale and Feldberg found that the substance appearing in the venous fluid corresponds in all its reactions to acetylcholine, and they believe that there is no reason to doubt that it is that substance. It should be noted that the concentrations of acetylcholine found in the venous fluid during activity of the glands were low in comparison with those obtained from some other active organs. There can be no reason for suspecting that the concentration in the fluid from the glands alone does not represent an output fully adequate to account for the transmission of the secretory stimulus. A further deduction is justified, namely, that the sweat glands of the

human skin, similarly sensitive to pilocarpine and atropine and indifferent to epinephrine, are supplied by cholinergic sympathetic fibers. In other animals the sympathetic fibers to the sweat glands appear to conform to the normal type in chemical function, being epinephrinergic in the horse and in the sheep.

The authors refer to the observations made by several workers of cases due to a cholinergic component in the sympathetic fibers. They state that the existence of cases such as these makes it desirable to emphasize that they are relatively rare exceptions to the generally epinephrinergic nature of peripheral sympathetic effects. Even the vasodilator effects of sympathetic nerves, as seen in the Carnivora after the administration of egotoxine, are predominantly epinephrinergic, being produced by injections of small amounts of epinephrine even more readily than by stimulation of the nerves, though these may in some cases contain cholinergic fibers, also of true sympathetic origin. A good example of the complicated physiologic picture which may result and of the readiness with which it can now be interpreted is given by Langley's (1933) description of the vasomotor changes in the pads of the cat's foot in response to stimulation of the sympathetic nerve supply. The predominant feature of the response was vasoconstrictor pallor, but this was often followed or preceded, interrupted or even replaced by flushing. Atropine removed the vasodilator component, having an uncomplicated vasoconstrictor effect. Langley attributed this atropine-sensitive vasodilatation to the escape of some metabolic product of the activity of the sweat glands. Dale and Feldberg attribute it to leakage on to the blood vessels of acetylcholine, released to transmit the secretory sympathetic impulses. Langley confirmed the observation of Dale that after the administration of ergotoxine sympathetic stimulation caused uncomplicated flushing of the pads; he found also that under these conditions a vasodilator action persisted after further injection of atropine. Ergotoxine, accordingly, revealed an epinephrinergic vasodilator component in the sympathetic effect on the blood vessels, distinct from the cholinergic effect secondary to the transmission of stimuli to the gland cells. The general rule that postganglionic fibers in the parasympathetic parts of the system are cholinergic, and that those in the sympathetic part of the system are epinephrinergic still holds; but there are exceptions to this rule and the recognition of these will clear up a number of outstanding anomalies.

ALPERS, Philadelphia.

VARIATIONS IN THE ACTIVITY OF THE RABBIT HYPOPHYSIS DURING THE REPRODUCTIVE CYCLE. R. T. HILL, J. Physiol. **83**:129 (Dec. 31) 1934.

The discovery that ovarian activity is primarily controlled by substances elaborated in the anterior lobe of the pituitary gland implied cyclic activity of the latter. Attempts to demonstrate such a cycle in the anterior part of the hypophysis have been made by two methods: (*a*) histologic examination and (*b*) determination of the amount of gonadotropic substances present in the pituitary gland at the various phases of the reproductive cycle. The former does not give decisive results. Hill used the rabbit ovulation test, since this is superior to the other method of assay, namely, the determination of the power of the hypophysis to cause growth of the ovary of the immature rat or mouse.

Other investigators have shown that rapid functional changes take place in the pituitary gland soon after mating. In order to obtain accurate knowledge of these changes in the anterior lobe of the pituitary gland of rabbits, Hill obtained and assayed pituitary glands of rabbits at various stages of the cycle, using the rabbit ovulation test. The entire pituitary glands were collected from female rabbits. Those collected at thirty minutes post coitum were obtained by decerebration, and the others, by killing the rabbits at the desired stages. Animals which were to be killed in estrus were isolated for a month. Pituitary glands obtained post partum were collected usually fifty minutes after the delivery of the first young.

The assay of hypophyses from animals in estrus gave a comparatively high figure, i. e., 1,560 units per gram. As the average weight of a desiccated pituitary gland from a rabbit in estrus is 7.8 mg., and 0.64 mg. equals 1 unit, the average gland before mating contains about 12 ovulation units.

Pituitary glands collected thirty-nine minutes post coitum demonstrated that these glands were about 80 per cent as active as those from animals in estrus. Twenty-four hours after mating ovulation had occurred in a rabbit in estrus and corpora lutea had begun to form. Assay at this time showed that only 210 units per gram remained in the tissue; 1 unit for each 4.7 mg. or 1.5 units per pituitary gland. The ovulation-producing substance dropped to one-eighth of the amount found during estrus. Hill expressed the belief that probably most of the secretion takes place in the first two or three hours following coitus.

As pregnancy continued, the potency of the hypophysis increased rapidly. At the end of fifteen days the units per gram of hypophysis had increased to 2,500. During the late stages of pregnancy (twenty-five days), the potency had fallen to 1,000 units per gram of pituitary tissue. Fifty minutes post partum, the units per gram were 1,330. Postpartum rabbits returned to estrus in about two or three days in the absence of suckling young. A curve showing the variation in the activity of the hypophysis was completed at thirty-three days post coitum by a duplication of the original estrus value.

The pseudopregnant phase was about two-thirds the length of true pregnancy. The cycle in the pituitary gland appeared to be similar in the two conditions, the pseudopregnancy being a contracted version of the curve for true pregnancy.

Hill states that the greater duration of the cycle in pregnancy than in pseudopregnancy is due to the presence of fetuses, and confirms the supposition of an embryo-pituitary relationship. The drop in pituitary content of the hormone after mating is accompanied by rapid secretion. The rise of the content during the early growth of the corpus luteum almost certainly means a low level of secretion.

PALMER, Philadelphia.

SPECIES VARIATION IN THE GONADOTROPIC ACTIVITY OF THE HYPOPHYSIS. R. T. HILL, J. Physiol. **83**:137 (Dec. 31) 1934.

It is recognized that the hypophyses of different species vary greatly in their power to stimulate the gonads of test animals. Most of the work has been done with immature rats or mice as the test animals. The rabbit ovulation test, used by Hill, however, is much more satisfactory. Ten rabbits in estrus were used for each preparation except where otherwise specified. The rats used were from 23 to 25 days of age when injections were begun. They were given two daily subcutaneous injections for five days and were killed on the sixth day. The pituitary glands of a large number of animals were collected immediately after death. The whole gland was taken except in the case of the glands from oxen, sheep and pigs, of which only the anterior lobe was obtained. The sex condition of all animals was known except in the case of cattle, pigs and sheep, the glands from which were collected at random and may have included those from pregnant females and castrated males. All injections were made in the form of suspensions of the desiccated powder.

Throughout the experiments there was observed a marked lack of similarity between the potency of the glands of the two sexes of a species and between the potency of the glands of closely related species. The pituitary glands of male cats gave an extremely high result, 3,120 units per gram. Those of male guinea-pigs gave only 90 units per gram. The pituitary glands of male dogs were weaker than those of the females, with 510 as against 1,230 units. No correlation was found in the primates tested, man and the Hamadryas baboon, the results being 620 and 2,500 units, respectively. Hill states that the anterior lobes of the pituitary glands of the horse and swine are equally potent by the rabbit ovulation test, being nine times more potent than that of the ox. The anterior lobe of the pituitary gland of the sheep is eleven times more potent than that of the ox. Assayed on immature rats, the pituitary glands of horses are much the strongest; next in order of potency are those of sheep and swine.

Gonadectomy of the animals tested (male and female rabbits and male cats) results in a significant decrease in the power of the pituitary gland to cause ovulation in the rabbit.

The author points out the difference between the assay on immature rats and that on rabbits in estrus. A substance which may prove gonadotropic in one test animal may not prove so in another species. PALMER, Philadelphia.

A CASE OF SIMMONDS' SYNDROME. R. S. AITKEN, Lancet **2**:802 (Oct. 13) 1934.

A man, aged 50, became acutely ill with hyperpyrexia, weakness, vertigo and emesia. After three days he began to recover, but loss of sight in the left eye was noted. For the remaining ten months of life the patient suffered from the effects of deficiency of the pituitary gland, which in his case consisted of moderate wasting, great general weakness, low blood pressure, low level of blood sugar and attacks of vomiting and prostration. These attacks and the hypotension were reminiscent of Addison's disease, and postmortem examination revealed a secondary atrophy of the adrenal glands. The syndrome appeared after destruction of the pituitary body by hemorrhage and an included chromophobe adenoma of the anterior lobe. BECK, Buffalo.

A CASE OF SIMMONDS' DISEASE. ALLEN B. BRATTON, Lancet **2**:806 (Oct. 13) 1934.

A woman, aged 41, showed all the classic symptoms of Simmonds' disease. There was an insidious onset toward the end of a long series of pregnancies, with progressive weakness and debility, amenorrhea and loss of pubic and axillary hair, headache, vomiting, anorexia and subnormal temperature. At one time the symptoms suggested a mild degree of hypothyroidism. The most unusual feature of the case was the absence of obvious muscular atrophy. Necropsy showed destruction of the anterior lobe of the pituitary gland and atrophy of other endocrine glands. Microscopically, there were unusual changes in only two organs, the pituitary and the thyroid gland. Not only was the anterior lobe of the pituitary gland almost completely destroyed, but there were also atrophic changes in the posterior lobe. There was simple atrophy of the thyroid gland with fibrosis and lymphadenomatous infiltration. BECK, Buffalo.

ACROMEGALIA AND SYRINGOMYELIA. L. LANGERON and LE DOURNEUF, Rev. franç. d'endocrinol. **12**:471 (Dec.) 1934.

On the basis of a clinical observation made on a patient presenting signs of acromegalia and syringomyelia, Langeron and Le Dourneuf discuss the various aspects of this combination. The case reported is that of a man, aged 56, who presented the following signs: enlargement of the skull, prognathism without macroglossia, kyphoscoliosis with deformity of the thorax, enlargement of the hands with normal skin and normal cellular tissue, Aran-Duchenne type of atrophy of the thenar, hypothenar and interosseal muscles, diffuse atrophy of the muscles of the right lower extremity with hypertrophy of the bony structures of the knee joint and of the ankle, moderate enlargement of the feet, active deep reflexes in the upper extremities, absence of right patellar and ankle jerks, complete athermesthesia and analgesia with intact tactile sense in the right leg and less definite sensory changes in the left leg and in both upper extremities (hot taken for cold and vice versa). Roentgenologic studies revealed enlargement of the frontal sinuses and of the sella turcica.

Reviewing cases reported in the literature, the authors discuss the three classifications suggested by MacBride in 1925. In one group, cases were assembled which were originally described by Charcot and Brissaud under the name of *cheiromégalie*, a condition in which a hand is mainly affected. The hand is usually enlarged, but is not edematous; the fingers are elongated, though not uniformly. The bony structure is intact, while the soft tissue only is involved. As a rule, it is a unilateral manifestation appearing very early or very late in life. There are, in addition, trophic changes and signs of an autonomic character, such as increased derma-

tographia. No histologic changes are present in the pituitary gland in these cases; the pathologic change is in the spinal cord. Froment, Exaltier and Josserand believed that the disturbance is autonomic-vegetative in nature.

To the second group belong cases in which there is a combination of signs of syringomyelia and acromegalia, cases in which again no evidence of involvement of the pituitary gland can be established. Here belong cases in which there are hypertrophy of one arm and signs of syringomyelia. While in some cases of this group the skeletal structures showed changes, in others only the soft tissues were involved. Cases have been reported of involvement of several extremities and also of the cranium. Holschewnikoff found enlargement of the central canal with glial proliferation in the neighborhood but a normal hypophysis in a case which he reported. Similar anatomic findings were reported by Petren. Pierre Marie believed that this entity does not represent a combination of syringomyelia and acromegalia, since no changes in the pituitary gland were found in any of the cases studied, and that therefore it must originate in the spinal cord.

The third group comprises cases with signs of both acromegalia and syringomyelia, with definite evidence of pathologic changes in the spinal cord and in the hypophysis. Although the authors cannot offer anatomic proof for their own case, they believe that it falls into this last group. NOTKIN, Poughkeepsie, N. Y.

THE VEGETATIVE FUNCTIONS OF DOGS AFTER EXTENSIVE ELIMINATION OF CENTRAL IMPULSES. N. F. POPOFF, Arch. f. d. ges. Physiol. **234**:137, 1934.

Continuing the experiments of Goltz and Ewald, Popoff destroyed the spinal cord below the fifth cervical vertebra and severed the vagus nerves in the neck. The animals survived for from five to twenty-five days. Metabolism, regulation of body temperature, circulation, growth of hairs and nails and the formation of scar tissue were studied. All these functions were more or less restored within a few days. Fever was still produced. One animal gave birth to a normal puppy and could nurse it. It is assumed that the peripheral network of ganglia and nerve fibers can still regulate the vegetative functions if the central impulses are eliminated. SPIEGEL, Philadelphia.

Cerebrospinal Fluid

THE RELATION OF NEGATIVE PRESSURE IN THE EPIDURAL SPACE TO POSTPUNCTURE HEADACHE. WILLIAM M. SHEPPE, Am. J. M. Sc. **188**:247 (Aug.) 1934.

It is suggested that continued leakage of spinal fluid from the dural sac is the predominant cause of postpuncture headache. With the use of a needle not larger than 22 gage with a sharp tapered point, and the practice of slow withdrawal of the needle with full time allowance for the entry of air to the subdural space, the complication of headache has been almost completely removed. These precautions have resulted in marked reduction in the incidence of postpuncture headache from 10 to 3 per cent in the author's series. MICHAELS, Boston.

THE BLOOD-CEREBROSPINAL FLUID BARRIER, WITH SPECIAL REFERENCE TO CHANGES IN GENERAL PARALYSIS AND IN DEMENTIA PRAECOX. JULES MASSERMAN, Psychiatric Quart. **9**:48 (Jan.) 1935.

Normal persons under medication with bromide show three times as much bromide in the blood as in the spinal fluid. This ratio is usually diminished in persons with organic diseases of the central nervous system and increased in those with certain of the major, apparently nonorganic, psychoses. Masserman examined the fluids of twenty-eight patients with dementia paralytica and of twenty-two with schizophrenia to determine the ratio of bromide in the blood to that in the spinal fluid. Each patient received 1 cg. of sodium bromide in aqueous solution per pound of body weight. This dose was administered three times a day for five

days. On the sixth day specimens of cisternal fluid, venous blood and spinal fluid were examined for bromide content.

The average bromide content of the spinal fluid in cases of dementia paralytica exceeded that in cases of schizophrenia by 3.6 mg. per hundred cubic centimeters. The bromide content of the blood was practically the same in the two groups. It appears therefore that the permeability of the barrier between the blood and the spinal fluid was lower in the cases of dementia paralytica than in cases of dementia praecox.

DAVIDSON, Newark, N. J.

LUMBAR PUNCTURE AND THE CEREBRO-SPINAL FLUID IN 2,000 CASES OF MENTAL DEFICIENCY. K. C. L. PADDLE, J. Ment. Sc. **80**:674, 1934.

This article represents the results of examination of the spinal fluids of the entire population of a large institution for the mentally defective. A study was made of the effect of the lumbar puncture on the patients as well as of the results of chemical and biologic examinations. In spite of the facts that careful technic was employed, a small bore needle was used, only a small amount of fluid was removed, rest in bed was enforced and the head was kept low for forty-eight hours with elevation of the foot of the bed, 17 per cent of the patients had symptoms of postlumbar puncture. Some of the patients vomited (14.2 per cent) and others had headaches (6.8 per cent). There was a definite relationship between the rate of flow and the incidence of symptoms of postlumbar puncture—the more rapid the flow of the fluid the more frequent was the incidence of the symptoms afterward. Only fifty-five spinal fluids, or 2.7 per cent, were abnormal. In thirty-two cases there were excessive cells, and in forty-four cases, excessive globulin; the colloidal gold reaction was positive in thirty cases, and the Wassermann reaction was positive in nineteen cases. The congenital syphilitic group was responsible for the majority of the abnormal cerebrospinal fluids. Abnormal spinal fluids were found in 23.9 per cent of the cases. The next largest group of patients showing abnormal spinal fluid were those suffering from dementia paralytica or epilepsy. Of fifty-four persons with mongolian idiocy only one showed a positive colloidal gold curve. In the remaining fifty-three cases the spinal fluid was normal in every respect.

KASANIN, Howard, R. I.

GENERAL FUNDAMENTALS OF THE EXCHANGE OF SUBSTANCES BETWEEN THE CENTRAL NERVOUS SYSTEM AND THE REST OF THE BODY. F. K. WALTER, Arch. f. Psychiat. **101**:195 (Dec.) 1933.

Walter discusses the modern conception of the exchange of substances between the central nervous system and the rest of the body on the basis of his own experiments and those of other authors and concludes that there is an active exchange of substances, the process depending on definite mechanisms. The means through which the exchange takes place can be looked for in the following three mediums: (1) the peripheral nerves, (2) the cerebrospinal fluid and (3) the blood. The first medium does not play a great rôle in this function; the most important feature to be considered is that of the introduction of toxins and bacteria into the central nervous system. The second, the cerebrospinal fluid, should not be regarded as the sole nourishing fluid of the central nervous system, first, because it does not admit colloids and, second, because the replacement of a large amount of cerebrospinal fluid by air or other fluids does not, as far as is known, produce any ill effects on the brain, consequently, the blood must be considered as the most important nutritive agent of the central nervous system.

The fact that certain substances, when introduced into the blood, can enter into a number of tissues and organs but do not reach the central nervous system leads one to assume that there must be some barrier between the nervous system and the rest of the body which selects certain substances and rejects others. According to Walter, three such barriers must be considered: (1) that between the blood and the vessels of the pia, which must be regarded as a semipermeable

membrane; (2) that between the cerebrospinal fluid and the brain, which must be looked for in the ventricular ependyma and the surface of the brain and is probably also semipermeable, and (3) that between the blood and the brain, which is to be found in the capillaries of the brain and, in contradistinction to the other barriers, is permeable to colloids. Two methods enable one to decrease or do away with such a barrier: (1) the administration of substances which cause a lowering of the resistance of the barrier, such as endocrine preparations and drugs, and (2) the introduction of substances directly into the cerebrospinal fluid or into the brain substance itself.

MALAMUD, Iowa City.

Special Senses

UNILATERAL CENTRAL AND ANNULAR SCOTOMA PRODUCED BY CALLUS FROM FRACTURE EXTENDING INTO OPTIC CANAL. WALTER I. LILLIE and ALFRED W. ADSON, Arch. Ophth. **12**:500 (Oct.) 1934.

Lillie and Adson report an unusual ophthalmologic syndrome observed in two cases after fractures along the base of the skull; in both cases the fractures, which involved the optic canal, were not revealed by roentgenograms. Ophthalmologic examination gave negative results, but two months after the accident changes occurred in the visual acuity. In both instances the fields showed an absolute central scotoma in the affected eye with a large annular scotoma surrounding the central scotoma. The findings in the two cases were so similar that they might be classed as almost pathognomonic. In each instance, on a second examination the roentgenograms showed narrowing of the optic foramen on the involved side. Permission for operation was refused in one case, but in the second case operation revealed that the narrowing of the optic foramen was due to the development of a callus, which had compressed the optic nerve to about two thirds of its normal size. In this case, while the operation was successful, there was no subsequent improvement in vision. It is probable that the lesion had progressed too far; decompression of the optic nerve was performed.

SPAETH, Philadelphia.

OCULAR LESIONS RESULTING FROM THALLIUM ACETATE POISONING AS DETERMINED BY EXPERIMENTAL RESEARCH. CHARLES MARION SWAB, Arch. Ophth. **12**:547 (Oct.) 1934.

During the past few years there have been frequent references to cases of thallium poisoning. Among these are reports submitted by ophthalmologists, who showed by various clinical methods that the visual disturbances caused by thallium intoxication were due to inflammation of the optic nerve. Swab experimented with animals, using three different types, to determine the extent of damage that might occur in the eyes and their adnexa from the effects of thallium. At the autopsies, macroscopic and histopathologic studies convinced Swab that thallium acetate is fatal to animals even when administered in small doses. All animals presented evidence of pathologic changes in every part of the visual pathway, including even the cortex of the occipital lobe. The lens seemed to be the only structure of the eyeball that was not affected by the intoxication. The eye itself showed massive round cell infiltration, frequently in the ciliary body as well as in the retrobulbar tissues.

SPAETH, Philadelphia.

A STUDY OF THE DEVELOPMENT OF THE COCHLEA AND COCHLEARIS IN THE FETAL ALBINO RAT. DONALD D. MCROBERTS, J. Morphol. **56**:243 (Sept.) 1934.

Transverse and frontal serial sections were made of the heads of fetal rats (15, 17, 19 and 20 days of age), as well as of new-born rats. It was found that the cochlea of the adult albino rat had two and one-half full spiral turns; this stage of development was attained by the nineteenth to twentieth day of fetal life, and

the cochlea was by then cartilaginous. At birth all structures were not fully developed, and no ossification had taken place. On the fifteenth day of fetal life only the ductus cochlearis and the mesenchymal modiolus were present. On about the nineteenth day, when the ductus cochlearis had almost reached two and one-half turns, the scalae, hair cells, tectorial membrane and the tunnel of Corti (starting as a groove in the surface at the position between the inner and the outer hair cells) began to develop simultaneously; then there followed a rapid growth of the modiolus. A detailed description of the gross and histologic anatomy of the inner ear is given, with tables of measurements of the heights of the turns of the cochlearis, the tunnel of Corti and the hair cells. The radial distance between spiral ligaments at the various stages of development was studied.

WYMAN, Boston.

EXPERIMENTAL RESEARCHES ON THE ANATOMY OF THE CENTRAL ACOUSTIC SYSTEM. F. E. POSTHUMUS MEYJES, Encéphale **29**:433 (July-Aug.) 1934.

This study deals with the auditory conduction paths from the internal geniculate body to the cortex. It involved work on adult rabbits with study of serial sections. The results were as follows: 1. An important corticofugal connection exists between the whole temporal area and the homolateral internal geniculate body. 2. The deep nuclei are the ones principally receiving these connections. 3. The frontal segments of the nuclei of the internal geniculate body are most important in the sense that the anterosuperior temporal areas are projected only onto the anterior portions, while the postero-inferior temporal areas are projected over the whole extent of the nuclei. 4. Probably the most inferior of these geniculate nuclei, which is considered by some observers as a portion of the posterior part of the lateral thalamic nucleus, receives fibers only from the anterosuperior temporal area. 5. There appear to be no corticofugal fibers to the suprageniculate nucleus. 6. Possibly there is a temporofugal connection with the corpus Luysi.

ANDERSON, Los Angeles.

Basal Ganglia

STRIATAL EPILEPSY. GERTRUD SOEKEN, J. f. Psychol. u. Neurol. **46**:329, 1934.

Soeken describes seven cases of striatal epilepsy in children ranging in age from 1 to 14 years. In all the cardinal symptoms of the striopallidal symptom complex were more or less marked, being manifested by rigor mobilis, occasional hypotonia, amimia, poverty of movement and a tendency to rigidity due to protracted rigor. Only one of the children came to necropsy, which disclosed cellular destruction in the pallidum; the pathologic changes, however, were diffuse and varied in nature, so that although a definite diagnosis could not be established the changes in the pallidum were ample to account for the rigor. In three of the patients there were observed clonic twitchings of the facial muscles, and in two others similar twitchings were reported anamnestically. The author believes that these twitchings are to be regarded not as manifestations of cortical involvement but as primitive reflex movements. This opinion is based on Rothmann's experiments in animals in which stimulation of the striatum was followed by tonic convulsive seizures and clonic movements of the eyes and nose.

All patients showed a marked horizontal nystagmus, the cause of which could not be ascertained clinically. The seizures were also associated with vegetative phenomena characterized by rapid breathing and more or less redness of the entire body during the attack and great pallor after it. Following the seizures the children became exhausted and relaxed, and most of them slept for a long period. There was apparently no loss of consciousness, no biting of the tongue and no involuntary urination. There were no evidences of involvement of the pyramidal tract. The reaction of the pupils to light was sluggish and in some of the children was not elicited.

The epileptiform seizures were tonic in nature and corresponded to what is generally recognized as pallidal or striatal epilepsy. During the seizures every patient assumed a body attitude which was apparently characteristic for that particular person and was most likely dependent on the extent of the pathologic process. The distribution of the rigor seems to be a determining factor on the body attitude during the attack; the muscles mostly affected by rigor mobilis also showed the greatest contractions. In addition to these tonic contractions, there may also occur more primitive synergisms and postural reflexes and *Stellreflexe* which may be severe enough to overcome the effects of the rigor. The body attitudes assumed by the patients during the seizures may be conceived as a sudden increase of muscle rigor giving rise to a protracted tonic contraction. The tonic stretch of certain muscle groups exerts reflexly a postural effect on other muscle groups which correct the body attitude produced by the rigor of these muscles. It is generally recognized that in addition to these two factors which influence body attitude there must exist other determining factors; these, however, have not as yet been demonstrated. In spite of this, the author believes that the rigor and the postural reflex and *Stellreflex* are the actual determinants of the tonic seizures in these cases.

KESCHNER, New York.

SOME ASPECTS OF HEPATOLENTICULAR DEGENERATION AND ITS PATHOGENESIS. EINAR SJÖVALL AND ARVID WALLGREN, Acta psychiat. et neurol. **9**:435, 1934.

A boy, aged 10 years, complained of abdominal pain, jaundice and pallor. The blood picture showed a severe degree of hemolytic anemia. The liver was enlarged; there was no ascites, and there were signs of mild irritative nephritis. Under treatment, the blood picture and general condition improved, and the patient was discharged. Because, at the same time, several other children were treated for similar symptoms following an epidemic of acute hepatitis prevalent in the locality the preceding year, a diagnosis of subacute hepatitis was made also in this boy's case. Two years later the boy returned to the hospital. He had tremor, masklike facies, spasmodic crying and laughing, rigidity and Fleischer's corneal ring. The liver was still enlarged, but the blood picture was satisfactory. A diagnosis of hepatolenticular degeneration was made. The patent died four years after the onset of the first symptoms. Autopsy showed nodular cirrhosis of the liver, a symmetrical softening confined to the lenticular nuclei, and symmetrical softening in the subcortical white matter of the first and second frontal convolutions. Other parts of the brain were not affected. Histologic examination revealed primary degeneration in the lenticular nuclei, with increase of microglia and much proliferation of blood vessels but without evidence of fibrous macroglia or of Alzheimer's cells. Thus, the condition was typical of Wilson's disease without the so-called "pseudosclerosis" component of the lesion in the brain.

Sjovall and Wallgren point out that in this case the hepatitis distinctly preceded the lesion of the brain; that the jaundice which was present at the onset of the disease was not of hepatic but of hemolytic nature, and that certain diseases of the liver may be associated with icterus of hemolytic nature, the hepatic cirrhosis in Wilson's disease being of such a nature. They believe that the primary disease of the liver and the destruction of the red blood corpuscles in their case were closely associated with one another; that the degeneration in the brain in Wilson's disease is due to a metabolic disturbance of a unique kind, with a tendency to increasing injury to the areas within the brain susceptible to this disturbance, and that the primary disease of the liver exposed these susceptible areas in the brain to the injurious action of this unique metabolic disturbance.

YAKOVLEV, Palmer, Mass.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY AND NEW YORK ACADEMY OF MEDICINE, SECTION OF NEUROLOGY AND PSYCHIATRY

Joint Meeting, May 14, 1935

C. BURNS CRAIG, M.D., *President, in the Chair*

ENDOCRINE THERAPY IN A CASE OF PSYCHIC DISTURBANCES RELATED TO THE MENSTRUAL CYCLE. DR. WILLIAM A. HORWITZ and DR. MEYER M. HARRIS (by invitation)

A school girl, aged 16½, for the past four years has had brief periodic psychotic episodes. The hereditary background is distinctly unfavorable. Her father was admitted twice to a hospital for patients with mental disease, once with a diagnosis of manic-depressive psychosis and again with a diagnosis of dementia praecox. One brother is serving a third term in prison; several other members of the family are psychopathic. Between the ages of 6 and 12 the patient had annual attacks of chorea, lasting from two to three months, but despite this there is no evidence of cardiac involvement at present. The girl is of a short, pudgy, dysplastic habitus and exhibits no signs of myxedema. At the age of 14 she had reached the ninth grade in school; her intelligence quotient, determined on three occasions during her stay in the hospital, has been 80.

In January 1931, at the age of 12½, she became depressed and retarded; she cried and refused to go to school. She ate and talked little. This state lasted for eight days. On the ninth day she was well and assumed her former activities. At about monthly intervals the short periods of depression and retardation recurred. The first four occurred before the catamenia were established. With the first menstrual period, at the age of 13, the patient had a fifth attack and for the next year every menstrual period was accompanied by a similar state of depression. In the interval between attacks she appeared well.

With the menstrual period of September 1932 she again became depressed, but instead of recovering on the ninth day, she became noisy, excitable and overactive and talked incessantly. This lasted an additional eight days, when she again seemed well. Because of this disturbed state she was admitted to the New York State Psychiatric Institute and Hospital on October 18. In a few days she complained of headache, became careless of her appearance and began to pick quarrels with other children. This behavior lasted for about two weeks, until a day or two after the menstrual period, when she became excited and rushed about the ward, giggling and tearing her clothes. She laughed and sang, was elated and expressed grandiose ideas of wealth, saying that she had servants and expensive clothes, etc. She was distractible and showed a flight of ideas, with rhyming and clang association. This state lasted for another two weeks; then she rapidly became quieter and in two or three days recovered completely.

Two weeks later another attack began, and since they have recurred at intervals of from two weeks to two months, except during a prolonged period of therapy with thyroid, during which she was apparently well. In all, she has had about 30 attacks, including those prior to her entrance to the hospital. All the attacks, except the first four, which had occurred before the catamenia were established, were associated with a menstrual period. Most of them began before the menstrual period; a few occurred either during it or a day or two after it had ceased. The onset was similar; there were prodromes consisting of a feeling of

sleepiness, untidiness in appearance and complaints of headache and backache; these were followed by mild disturbances in behavior such as silliness, flippancy and seeking attention for various physical complaints. The prodromes lasted a few days and were replaced by a short period of depression, followed by a disturbed, elated state of a few days' or weeks' duration. On two or three occasions the depression recurred without the appearance of the disturbed state.

The menstrual periods occurred irregularly at intervals of from two weeks to two months; each period was accompanied by a psychotic episode. The anterior pituitary-like gonadotropic hormone from the urine of pregnant women and theelin were given at the beginning or prior to the onset of an attack or during the psychotic state and were apparently without any effect. Since the basal metabolic rate ranged from —14 to —34, 3 grains (0.19 Gm.) of thyroid was given daily for two months. During this time the patient had a menstrual period accompanied by very mild psychotic symptoms. When the administration of thyroid was discontinued the basal metabolic rate, which had risen to a normal level, again dropped to —25, and with the next menstrual period a markedly disturbed mental state occurred, which lasted for about one month. From 10 to 15 grains (0.65 to 0.97 Gm.) of thyroid administered daily during this psychotic period produced no beneficial effect. It was then decided to administer sufficient thyroid to raise the basal metabolic rate to a positive level. For six and one-half months an average of 8 grains (0.52 Gm.) was given daily; for the last four months of this period the basal metabolic rate averaged +15. During this period of six and one-half months the patient had five menstrual cycles without a psychotic episode. At the end of the period the medication with thyroid was discontinued, and the psychotic episodes recurred with the next two menstrual cycles. During the second of these periods tablets resembling thyroid were given as a placebo. Therapy with thyroid was again instituted. The first menstrual period following resumption of this therapy was accompanied by only a mild disturbed state, which lasted about ten days. The patient has had four more menstrual periods free from a state of either depression or overactivity, only mild prodromal symptoms appearing at about the time of each period.

DISCUSSION

DR. HOWARD W. POTTER: It seems to me that this case emphasizes the close relationship between psychiatry and internal medicine. One must be careful not to jump at conclusions, however, from one such instance, no matter how striking the results appear. This girl appears to have a rather serious constitutional condition, if the rest of the family history is kept in mind. In addition to the constitutional factors, do the choreiform attacks which she has had since the age of 8 represent true chorea or a neurosis? There is apparently little known about this girl's inner mental life. A state of chronic anxiety resulting from emotional conflicts is sometimes expressed functionally through a breakdown of one or another of the somatic systems—in this case, the endocrine system.

DR. BELA MITTELMANN: The problem of psychic disturbances related to the menstrual period is complex, because psychic and somatic factors overlap in their effects. One of the first publications on disturbances of this nature was by Janet. His patient suffered from severe hysterical symptoms which appeared only during the menstrual periods. The condition disappeared under hypnotic treatment. Menstrual periodicity can be influenced by hypnosis, as was demonstrated by Forel. As is generally known, many psychic disturbances occurring during the menstrual period disappear with psychoanalysis. The modern approach to the problem from the point of view of endocrinology was first analyzed by Frank, who tested the level of estrogenic substance in cases of premenstrual tension. He found it elevated. His patients remained free from such symptoms as excessive emotional irritability, depression, etc., during the period of amenorrhea established by roentgen irradiation of the ovaries.

In Dr. Horwitz' case the somatic factor was undoubtedly primary. There is ample evidence that psychic factors can precipitate hyperthyroidism, but I do not believe that they can depress the function of the thyroid gland. This patient showed

hypothyroidism. I believe that both possibilities occur: Either the psychic or the somatic factor is primary in different cases. I wish to ask whether studies were made of the estrogenic or gonadotropic hormones in this case.

DR. IRVING PARDEE: As Dr. Horwitz was describing his patient I wondered what she looked like. Fortunately he brought her here and gave an opportunity to see her. She is short and fat; the secondary sex characteristics are well developed. Her features and hands are small; the fingers are short and tapering. This is the picture which one associates with hypopituitarism. What roentgen examination of the sella turcica showed is in doubt; its condition was only partly described. On the other hand, there was a disturbance in the sugar content of the blood; the amount of cholesterol was slightly increased and the basal metabolic rate was low. It is unfortunate, as has been previously mentioned, that studies of the ovarian hormones were not made consecutively. There is still an excellent opportunity to make such a valuable study. I feel that there is hypopituitarism, with a secondary deficiency in the activity of the thyroid and ovaries. All are familiar with the fact that the pituitary gland secretes a thyrotropic hormone which stimulates the thyroid gland and a gonadotropic hormone which stimulates the gonads. It does not necessarily follow that this patient has a deficiency of gonadotropic hormone, though she may have some deficiency in ovarian secretion. If an estrogenic preparation is used in conjunction with thyroid, I believe that there will be an improvement in the patient's clinical course.

In looking at this condition from its broadest aspects, I wonder what relation there is between the dyscrasia of the endocrine system and the psychosis. The psychotic episodes are associated with the menstrual cycle; the administration of thyroid has ameliorated the symptoms. The cause and effect seem obvious, and yet I do not think that this is the whole cause and effect by any means. I do not believe that the thyroid gland is responsible for the patient's psychic disturbance. She has menstruated irregularly since the onset of the menses; this disturbance is dependent on dysfunction of the pituitary gland and not of the thyroid. In many cases of manic-depressive psychosis there is a disturbance of the menstrual cycle, the cause of which is not known. I shall cite such a case, in which the estrogenic and gonadotropic hormones have been studied for several years. During the periods of amenorrhea there was absence of the estrogenic principle in the urine. The amenorrhea usually accompanied the attacks of depression. During the last attack of depression, which was in the summer of 1933, there was a sudden increase in the output of estrogenic substance; at first about 32 rat units, then 72 and 100 and then over 200 rat units was excreted in the urine. This occurred during the period of improvement; when the patient had recovered from the psychotic depression the amount of estrogenic substance secreted returned to normal. The next summer an acute manic episode again started, and large doses of ovarian hormone were given, with the result that the episode terminated in a few weeks. I do not know what this means. This is but one observation, and only repeated similar studies can lead to any conclusion. I do not want to leave the impression that I believe manic-depressive psychoses are caused by disturbances in the ovaries. I should not be so rash; but I do think that in cases of manic-depressive psychosis associated with menstrual disturbances there are associated disturbances of the endocrine system, which may be primary or secondary.

DR. RUSSELL MACROBERT: This presentation is interesting, and would be more so if Dr. Horwitz would give his interpretation of the biodynamics involved. I believe that the massive doses of thyroid exercised a depressant effect directly and primarily on the pituitary hormones and consequently and secondarily on the ovarian hormones and that the disturbed manic states were influenced in that way. I think too, more strongly than Dr. Pardee seems willing to admit, that the manic-depressive psychosis is closely related to certain disturbed pituitary-gonadal hormone relationships. The striking beneficial result one can obtain with the new 8,000 international unit doses of estrogenic substance is significant. With a single dose one is able to lift a patient from a deeply depressive to a normally

cheerful or even hypomanic state within the following twenty-four or forty-eight hours. When one has frequently done that, as I have recently, one cannot forget it. I have a suspicion from other recent observations that physiologically antagonistic agents more directly suitable than thyroid will be found to repress the manic reaction. In this case thyroid exerted a paralyzing effect on the overacting hormones which were disturbing the pituitary-ovarian harmony.

DR. W. A. HORWITZ: In this case no attempt was made at psychologic investigations, as we did not want to complicate the problem further. Studies on the excretion of sex hormones were made by Dr. Harris and Dr. Brand in a separate investigation over a period of two months. Their studies showed the excretion during that period to be normal. It is a question whether the cessation of the psychotic episodes resulted directly from the thyroid, from a hormone or from the increased metabolic state resulting therefrom. It has occurred to us that we could later substitute di-nitrophenol for the thyroid, and thus raise the metabolic rate and see if that also would avert the attacks. My own impression agrees with that of Dr. Pardee that the patient's condition is primarily due to a dysfunction of the pituitary gland. This gland secretes a thyrotropic hormone, and destruction of the gland results in atrophy and degeneration of the thyroid, with subsequent decreased metabolic activity. The periodicity is another factor which would lead us to believe that the condition is primarily due to dysfunction of the pituitary gland. These cases have been reported previously by Krafft-Ebing (Psychosis menstrualis, Stuttgart, Ferdinand Enke, 1902), who in 1878 reported 19 similar cases; in 1902 he published a monograph on "menstrual psychoses," which included personal observations on 44 cases and reports on 8 others which he collected from the literature. He believed that these were cases of "ovulation psychoses" and recommended castration. When castration had been carried out the results reported at times did not seem to justify the operation. In some cases the uterus had been removed as well as the ovaries, and still the attacks continued to recur regularly.

INVESTIGATIONS OF SMELL AND TASTE IN DIAGNOSTIC LOCALIZATION. DR. CAESAR HIRSCH (by invitation).

Methods worked out by physiologists and psychologists to test smell and taste have not yielded satisfactory results in diagnostic localization. The neurologist Börnstein has computed a sort of "smelling scale," using 12 substances graded in such manner that the intensity of smell increased gradually from the first to the fifth rung. In addition, four other odoriferous substances are used. At the same time two of them act markedly on the trifacial nerve. One acts on the sense of temperature, one on the sense of pain and the two others on the sense of taste. Hirsch has modified somewhat Börnstein's smelling scale and tried to differentiate peripheral and central lesions of the olfactory and gustatory system. To this end he follows up the smelling test immediately with the gustatory test, since it is known by experience that in many cases disturbances of smell and taste are confused. Again, many substances which have an odor contain a touch or taste component which is not perceived through the trifacial and glossopharyngeal nerves.

I have devised an apparatus for the testing of smell and taste which I call "olfactory and gustatory harmonium." The various odoriferous bodies are comprehensively graded so that one can carry out clinical examinations in a relatively short time.

My investigations show that in many cases it is possible to differentiate a functional from an organic olfactory or gustatory disturbance. When a patient complains of loss of smell and taste and examination reveals no changes in the nose, nasopharynx or tongue, one must be skeptical. If such a patient states that he can perceive neither the odorous substances nor the touch and taste components, one is safe in assuming that one is dealing with a psychogenic disturbance or malingering, because in a patient with an organic central disturbance the loss of all three components—olfactory, trifacial and glossopharyngeal—could hardly be

expected. If such were the case a number of other very grave symptoms indicative of lesions of the cranial nerves or of cerebral lesions would be present. The diagnostic localization of intracranial conditions by means of tests of smell and taste is still in its infancy. Cooperation between the rhinologist and the neurologist is necessary for further progress in this interesting field.

DISCUSSION

DR. ISRAEL S. WECHSLER: I find it difficult to discuss this paper, which apparently was intended more for the rhinologist than for the neurologist. The neurologist is trained to think in more precise terms on the physiology of the nervous system. Dr. Hirsch has, I fear, lumped together terms which the neurologist is wont to dissociate, namely, smell, taste, touch and flavor. The last is not a primary modality either of taste or of smell but a combination of both. One can have an intact sense of taste and be unable to distinguish flavor if the sense of olfaction happens to be affected. It is well known that if a person shuts his eyes and does not breathe through his nose he will be unable to distinguish, say, between chopped apple and chopped potato. If he is permitted to smell, he will immediately recognize them. He does taste in both cases, but lacking opportunity to smell he lacks the ability to distinguish flavor; therefore, one cannot say that the person has lost the sense of taste.

Dr. Hirsch also has rather erroneously brought in the trigeminal nerve, which has nothing to do either with smell or with taste. This nerve is merely host to the taste fibers which are supplied by the seventh nerve and go with those of the ninth nerve to one center in the medulla. The trigeminal nerve merely supplies touch and pain fibers to regions innervated, respectively, for taste and smell by other nerves. To confuse taste, smell and touch and refer them to the trigeminal nerve is not correct anatomically or physiologically.

I do not think that the cases which Dr. Hirsch reported are conclusive. A number of them are cases of outright malingering—a fact which is clear from the histories, as I read them, It is no new clinical observation that malingerers and hysterical persons will assert that they do not smell or taste or feel the touch when tested; but there are ways of detection, and no light is thrown on the various modalities. The cases of meningitis that have been presented obviously do not help in an understanding or elucidation of the problem of the sense of smell. Nor do the cases of ozena and malignant disease of the sinuses help much. In the case of fracture of the skull, it depends entirely on where the fracture is and what structures are affected. I find it difficult to explain the loss of sense of smell in the case of fracture of the posterior fossa.

The very difficult problem is one of devising methods for standardizing the stimulus and, if possible, also of standardizing the response. If one could devise such a method, one would have what is lacking at the present time. The "harmonium" is not such a device; at best, it is only a gradation of smells.

The attempt to devise a method of examination and to standardize it is important; recently, Elsberg, Brewer and Levy made such an attempt (*Bull. Neurol. Inst. New York* **4**:1, 1935). They have given what may be regarded as the beginning of an answer to the problem. Wisely they made their studies on normal persons first. I should say that the paper of Dr. Hirsch is useful in that it proves the need of precise methods of investigation, but I think that considerably more work is needed to answer the question.

DR. CAESAR HIRSCH: I was perhaps misunderstood because I abbreviated my paper very much. I did not intend to speak about the psychology of taste and smell; it was my purpose to bring out a practical method of investigation of smell and taste. And I think that I have chosen the right audience, because Börnstein Ueber den Geruchsinn, *Deutsche Ztschr. f. Nervenh.* **104**:55 and 78, 1928), on whose investigation my paper is based, is a neurologist. What Dr. Wechsler mentioned is well known to me. Of course if a person is given an apple or an onion to eat and closes his eyes and nose he cannot tell what he is eating. Therefore one always makes a rhinologic examination first.

In the cases of malingering, I wish to emphasize that the patients were sent for examination by psychiatrists and neurologists because they were unable to determine whether there was a functional or an organic loss of taste and smell. These problems are brought out more in detail in my paper.

THE PREPSYCHOTIC PERSONALITY IN INVOLUTIONAL MELANCHOLIA. DR. W. B. TITLEY.

This article will be published in full, with discussion, in a later issue of the ARCHIVES.

HEREDITY AND ENVIRONMENT: A STUDY OF A PSYCHOTIC FAMILY. DR. GEORGE W. HENRY.

As long as heredity and environment are treated as unrelated factors, the question of the part each plays in the genesis of mental illness will remain unsolved. Occasionally it is possible to inquire more deeply into the emotional relationships of a family, and when this method is employed one obtains valuable evidence of the ways in which heredity and environment reveal their influence in the life of the individual person.

In the family studied there was an unusually high incidence of manic-depressive psychoses. In my report the information was first set forth in the familiar routine manner, a type of presentation that emphasized hereditary factors. Individual members of the family were then described in detail, a type of presentation that emphasized environmental factors. From a consideration of the two points of view it is possible to visualize the genesis of the mental illness in its totality.

If the available information regarding this family were limited to the facts presented in the routine family history it would be difficult to escape the patient's own conclusion that mental depressions are inherited and that she was destined to follow the trend of her family. Often there is less information available about the emotional relationships of members in a family than was presented in this case, and yet it is a common practice of statisticians to deal only with recorded cases of mental illness, as though the emotional relationships within the family were negligible or at least isolated from the factor of heredity.

Fortunately, for this particular family there are reports from hospitals where several of its members have been treated, including detailed histories of four who were patients in the same hospital. Individual members were studied by different physicians, and it has been possible to verify statements and to supplement information.

On reconsideration of the history of this family it was evident that as far as mental illness is concerned final conclusions regarding the relative importance of heredity and environment cannot be attained. There is abundant material for stressing either, but any single emphasis would reflect the attitude of the observer rather than represent the facts. With such a high incidence of frank psychoses in a family, inherited potentialities may be assumed, but it is possible that equivalent tendencies might have been transmitted through environmental influences. Just as there are mutual attractions between persons of similar interests, so there appears to be a tendency for those with psychotic inheritance to unite. They have a mutual feeling of understanding and tolerance because of similar experience. Often they feel inadequate in the presence of a well adjusted person and may be deterred from marriage with such a person by a sense of unfairness to the mate and to the offspring. It is equally difficult to evaluate the purely environmental influences. The intimate relationships within this family and the frequent occurrence of tragic events must have colored the outlook on life and aided materially in the establishment of patterns of reaction. There is the possibility, however, that some of the members have survived by taking heed of the frequent examples of failure and observing extra precautions to live in a more hygienic way.

The problem of the interaction of heredity and environment has occupied the attention of learned men for centuries, and yet little more has been gained than

a better knowledge of its complexity. The slow progress made has been due largely to the fact that the distinction between the two factors is somewhat arbitrary. Perhaps the whole question is largely academic in importance, as a person inherits potentialities not only by way of the germ plasm but also the environment created by his antecedents. In any case, a careful study of their interrelationship is essential in the work of the psychopathologist and offers the method of approach which is the most practical in dealing with actual situations.

DISCUSSION

DR. JAMES H. WALL (by invitation): I am sorry that Dr. Henry was not able to read his entire paper. In the way of discussion there is little to be said, as respect has been paid both to heredity and to environment. It has been said that any character is the result of the interaction between heredity and environment; the same may be said of a person who is mentally sick. I think that it would be foolish to attempt to separate the seed from the soil. I think that psychiatrists in dealing with a sick person are likely to place too much emphasis on the immediate factors in the patient's environment. Too much is left as a residue which is charged to heredity or constitution. Certainly a more intensive and extensive study of what has happened to the patient from infancy to the time of his illness minimizes the rôle of heredity.

SUICIDE AND MENTAL DISEASE: A CLINICAL ANALYSIS OF ONE HUNDRED CASES. DR. GERALD R. JAMEISON (by invitation).

This article will be published in full, with discussion, in a later issue of the ARCHIVES.

LOS ANGELES SOCIETY OF NEUROLOGY AND PSYCHIATRY

Regular Meeting, May 22, 1935

LEO J. ADELSTEIN, M.D., *President, in the Chair*

SELF-INFLICTED ILLNESS AND CURE. DR. OTTO RANK, Paris, France (by invitation).

Every physician in the course of private practice sees patients whom he feels certain could be helped if only they did not resist the acceptance of the seemingly sought for help. This resistance to getting well was explained by Freud as "gain through illness;" it is supposed to be the principal reason that the patient remains sick in spite of the best medical care, both physical and psychologic, and his own desire to get well. It has been learned from such patients that medical treatment must remain ineffective unless the emotional attitude of the patient toward his illness and toward life in general can be changed. How such a fundamental change of attitude can be effected constitutes the main problem of modern psychotherapy as I see it developing out of the original psychoanalytic conceptions.

In the earlier days of this new therapeutic movement, when the psychoanalyst felt the powerful help lent to his work by what were then considered revolutionary theories and while the medical profession stood by waiting to see the results of their endeavors, this removal of resistance against getting well had to be left entirely to the psychologically trained specialist. Since then the medical practitioner has become more and more acquainted with these theories, which nowadays he almost automatically applies in making his diagnosis. The question at present seems to be whether and to what extent the general practitioner may attempt to remove, or at least to alleviate, the mental and emotional resistance against his medical treatment. No one doubts that such a combination of physical and mental

treatment would be the ideal for which to strive. At the same time it seems almost impossible that the practitioner should combine the two functions of organic and of psychologic specialist; yet in cases of functional symptoms even the family doctor with his understanding of human nature, supported by the full confidence of his client, was able to help his patients through these crises of resistance.

It is true that the medical practitioner cannot afford to go through the highly specialized training necessary for the psychotherapeutist who has to deal with cases of outspoken neurosis, in which physical, or rather functional, symptoms are obviously the result of mental and emotional conflicts. On the other hand, the early and fundamental psychoanalytic conceptions have been developed to a point where even in cases of neurosis a quick approach to the patient's basic resistance can be made without having to unravel his whole past in a long drawn out process.

Before I can indicate what this dynamic approach, as I call it, consists in and how it can be utilized therapeutically, I must tell in a few words how I transformed the freudian theory of the resistance to getting well into the human problem of accepting help and the gain through illness into what one may call a philosophy of human suffering. Independent experience taught me that the gain through illness does not imply the freedom from responsibility and the avoidance of adjustment to reality but has a much deeper meaning, rooted in man's basic conception of life. I shall state my thesis first and elaborate, explain and illustrate it as I go along. As a result of my experience I found that the illness not only is precipitated by the patient in order to withdraw from life but is nursed by him so that he can avoid responsibilities and adjustment to reality; Freud himself and his pupils found this motive insufficient to explain the resistance to getting well under their treatment. This gain through illness explains why the patient does not get well himself or rather does not make any efforts in that direction. But why the patient should resist the help of the specialist whom he finally consulted in order to get well had to be accounted for by a new theory.

Freud found this insurmountable resistance, as he called it, anchored in a deep-rooted feeling of guilt, which prevents the patient from getting well and enjoying life. But, instead of looking for the root of this seemingly indigenous guilt in the human being himself, Freud applied his original theory of environmental inhibition in its explanation; since it could not be overlooked that the person was somehow preventing himself from getting well and the freudian theory does not permit any other explanation than that this was due to conditioning from without, the concept of self-punishment was introduced in order to account for this unexpected resistance to getting cured. This idea of self-punishment is obviously a subjective repetition of the punishment from without, which was inflicted on the child and which the adult's super-ego—replacing parental authority—now inflicts on the instinctual self.

If this were so—or if this were all—any psychotherapy, especially along freudian lines, must be hopeless; as a fact, Freud himself sounded rather pessimistic on this score and saw a possibility for cure only in cases in which the sense of guilt is "borrowed," as he called it, that is, is taken over from another person by way of identification. But when freudian therapy has worked successfully in other cases, there must evidently have been some other relief from the guilt which enabled the patient to accept the help and get well. I should not be surprised if Freud and his followers had overlooked the possibility of the treatment's being conceived of by the patient as a punishment partly self-inflicted, acceptance of which enabled him to free himself from his neurotic guilt.

As soon as one allows some freedom of expression to the patient, who, so to speak, has to say a word himself and is not only a reproductive instrument deprived of will and autonomy, the whole problem takes on a different aspect. This positive, indeed creative, aspect of the problem leads to the conception that the illness not only is self-inflicted, a kind of punishment as Freud would have it, but is also

self-willed, a sort of creation which can find expression only in this negative, destructive way.

This evaluation of illness as an expression of the patient's creative will leads to a totally different conception, to a rehabilitation, I might say, of the neurotic person, who has been looked down on since the medieval days of witchcraft and deviltry. This scornful attitude, which even the modern therapeutist has for the seemingly weak neurotic person, goes back in the last analysis to his own personal need to make the helpless neurotic patient a symbol of his own evil and destructive self, just as the patient seeks in the therapeutist his creative self by means of identification. From this mutual dependence of the therapeutist and the neurotic subject, who represent two complementary types, it follows that the real therapeutic agent, the healing factor in psychotherapy, is not the psychologic self-knowledge and its theoretical formulation but the therapeutist himself, whom the patient wants to use as the positive completion of his predominantly negative self.

In order to use this dynamic relationship of the two complementary types therapeutically, it is necessary to understand the psychic play of forces which underlies it. To the basic biologic duality of instinct and fear, which psychoanalysis deals with exclusively, must be added the psychologic factor par excellence, namely, the individual will, which can manifest itself negatively in the form of inhibition (control) as well as positively as an expression of creative energy. However, this creative force, which I also see at the roots of mental or imaginative illness, is not sexuality, as the psychoanalyst assumes, but rather an antisexual tendency, which may be characterized as voluntary control of the instinctive life. More precisely stated, I conceive of the creative drive as the impulse life (including sexuality) put at the service of the individual will.

When the psychoanalyst speaks of the sublimation of the sex instinct, by which is meant its diversion from the purely biologic function and its direction toward higher goals, the question as to what diverts and what directs does not seem to be answered by reference to repression, because repression is a negative factor which can perhaps divert but never direct. Besides, the main question remains open: What originally causes repression? This question, as is well known, was answered by the theory of external deprivation, which again is a negative restriction. In contradistinction to this freudian explanation, on which the idea of self-punishment as a repetition of punishment from without is based, I assumed from the very beginning the existence of a self-inhibiting mechanism inherent in the subject. This instinctual inhibition, which operates as a self-preserving protection, I was able later to identify with the individual will. I understand will to be an autonomous organization for the control primarily of the impulsive self; this organization, however, represents the total personality, with its constructive capacity not only for ruling, developing and changing the surrounding world but for recreating its true self. In this sense, the neurotic person, with his potentialities for destruction as well as for creation, corresponds much more to the artist who has failed (*artiste manqué*) than to the ordinary type of person who has failed to achieve a normal development and adjustment to reality.

One must reckon, therefore, with the triad—impulse, fear and will—in the growth of the person. The dynamic relation and the interaction of these factors determine the prevalent attitude of man toward himself and the world at any given moment, or, after achievement of some kind of balance, his actual type of temperament and character, which in turn determines his social behavior.

However unsatisfactory it may be to put these dynamic processes into typical formulas, it is the only way to approximate clarity in this complicated matter. If one compares the neurotic with the productive type of person, it would seem that in the former the impulse life is too much repressed. According to whether this neurotic repression is affected by fear or by will, one has the picture of fear neurosis (hysteria or phobia) or of will neurosis (compulsion). In the productive type, on the contrary, the will dominates with a far-reaching control and activity, but with no exaggerated repression of the impulse life; thus, the impulse life

creatively freed both in the imaginative and in the social sphere relieves guilt through self-expression. In a third type, the so-called psychopathic type—to which the criminal also belongs—the impulse life remains unrepressed as in the productive type, but at the same time uncontrolled; in this type the will affirms the impulse life instead of controlling it. This type of person, in spite of appearances, is actually weak-willed because he is subject to his instinctual impulses, while the neurotic person, contrary to the common conception, really represents the strong-willed type who can exercise his will only negatively, using his will on his own self, which he has cut off from all expression in life. Schematically, one could state it thus: In the neurotic type fear has the upper hand; in the psychopathic type, impulse, and in the productive type, the will. In reality, these extreme types appear mixed for the most part and do not remain dynamically constant. On the other hand, it seems clear that a satisfactory love life, of which none of the three types is capable, unites all three factors in a harmonious way. The impulse life is satisfied in sex; the individual will fulfils itself in the choice and creative transformation of the mate, while fear is overcome by the love emotion. The sense of guilt is also reduced to a minimum, because of the different tendencies which operate dynamically in the personality are working with, instead of against, one another. In the psychopathic type a guilt reaction usually follows the impulsive action as a repentance; in the productive type a sense of guilt usually accompanies his creation, which it can influence in an inhibitive as well as in a stimulating way.

In the neurotic type, however, fear and guilt have quite a different origin and meaning. By that I mean that I do not see how these neurotic reactions can be explained as the psychoanalyst explains them, as mere exaggerations or intensifications of normal emotion. Although one may be tempted to introduce the medical conception of pathology into the sphere of the inner emotional life, I have never been able to see how the neurotic reactions of fear and guilt could be alleviated by a therapy which has as its goal a hardly definable normality. However, on the basis of my conception of the will and its creative operating in the building up of a neurosis, it becomes evident that the patient brings about not only his illness but also its prerequisites, fear and guilt. The general formulation of this state of affairs, which one recognizes time and again in cases of neurosis, can be presented thus; instead of affirming or asserting his will, the neurotic subject must find an excuse to prove to himself, as well as to others, his inability or incapability. That is to say, instead of saying "I don't want to do that," he must say "I cannot do it, because I am afraid or feel guilty."

This formulation contains the whole problem of neurosis in a nutshell, especially when one adds that in order to use unbearable fear and guilt as a real excuse to himself the neurotic subject must really experience them, that is to say, put up a straw man which he can use at will. It goes without saying that in order to create pathologic emotions of that kind the neurotic person must constitutionally deviate from the average; but even with regard to this constitutional factor I wish to make a distinction between two types of neurotic persons, who differ not only in their symptoms and the gain and suffering from them but also as to prognosis and the subsequent treatment they require. The one type is constitutionally neurotic, whatever that may mean; the other is essentially creative and becomes neurotic only because of misdirected creativity, whether it is through exclusive concentration on himself and his self-creation or through carrying his imaginative creation into the reality of life with which it is bound to clash. A person of the first type, whose creativity remains fixed on his own self, never reaches the point of constructively objectifying his productivity in work and can be helped only by being freed to do so; a person of the second type, the creative type, who becomes caught in his struggle not only with himself but with life, can be aided more definitely by separating the spheres of life and imagination, as a result of which he will operate better in both realms.

Fortunately, I find myself here in a position to bring the weight of testimony from the greatest psychologist in modern times, Nietzche. He anticipated not

only Freud and his psychology of repression, inferiority and resentment but also the social and spiritual crisis, which he analyzed in a masterly fashion on the basis of a relativity psychology of different groups, nations and classes. At the same time he himself, through his suffering, illustrates this process of self-created illness; he himself understood that it was more than self-inflicted punishment.

Nietzche not only affirmed his life-long illness but actually glorified it, because he discovered through his own experience that becoming well is of greater value than being well, that is to say, more constructive, indeed in a certain sense creative. In describing his own recovery he wrote: "I took myself in hand, I myself made myself sound again. This presupposes that one is sound at bottom. An essentially morbid type cannot become well, still less make himself well, while for an essentially sound type, on the contrary, illness can even become a powerful stimulant to continued and heightened living."

Nietzche recognized in himself the usual experience of the artist type, who often seems to be driven by illness and suffering to creative compensation in work; he also sensed the deeper truth, that both illness and work are the expression of the creative will. From my own therapeutic experience I learned that in cases of so-called self-inflicted illness the patient really strives for a recreation of the self and is blocked at the first step toward it, that is, in his attempt to destroy the old self. But even when he succeeds in emerging from this chaotic state of reformation the result is not only self-healing, which means health in the sense of a mere restoration, but something much more profound. Nietzche, through his self-healing, became not well but creative; that is, he was able to detach his productivity from his own bodily self and express it spiritually through the development of his personality in his work.

When one turns from the creative back to the neurotic type of person one sees that in him productivity remains exclusively confined to his own ego and manifests itself chiefly in negative expression. This implies, first, that he is unable to accept his self and has to reform it to improve it, not so much according to an ideal, which he may put up for himself, as does the creative type, but chiefly because he feels that he is inferior, bad and wrong. On this negative basis he is compelled to use his will to remodel himself; that is, he wills himself to be different. With the productive type, on the other hand, it is the creative urge emerging from the total personality which affects change by development and growth and not by will. The willing of the change is bound to change, because it cannot be willed as long as will is opposed to the rest of the self and hence becomes negative.

From this it follows that the neurotic person is hopelessly caught in the process of remodeling the given self into a willed ego. Then how can he be helped to extricate himself from his internal struggle from which he seemingly does not want to be liberated? To the first mentioned reason, that of avoiding responsibility by remaining ill, I can now add another more profound reason which makes the neurotic person resist, sooner or later, any attempt to cure him. It is his need to express his will, and since he has no other medium than his own self he exercises his creativity in that way. Hence it is less important for him than it seems to be that he should be really cured, because often his life would lose its whole meaning if he attained this goal; he would not only lose something to fight against and to struggle with—as a substitute for real life—but he would also lose the only thing he has to play with, namely, himself and his neurosis. Besides, to the neurotic person the attainment of any definite goal means the end, in the sense of death, even though this goal may be the end of a therapeutic treatment as its reward.

This explains why in any kind of psychotherapy the ending of the therapeutic process is the most difficult task for the therapeutist and demands a skill which comes only through experience. The most important thing I have learned in my career as a psychotherapeutist is that in order to achieve a satisfactory solution at the end one must carefully prepare for it from the beginning and not lose sight of it during the whole process. In doing so, one must respect the patient's own

attempts to help himself to get well and not increase his guilt by explaining them as resistance, although often these efforts manifest themselves as resistances to the treatment, that is, as resistance to accepting help from the therapeutist. One of the fundamental conflicts which are repeated by the neurotic person in the therapeutic relationship is his struggle against overdependence and his fight for an independence which he would not be able to bear if he attained it.

I wish to illustrate these wilful reactions in the patient during the course of treatment with regard to three essential situations: the initial situation, the final situation and the transitional process between the two. The patient's appeal for help usually signifies an autonomous step on his part to get well. It happens not infrequently that the patient unknowingly precipitates the crisis which forces him to seek the help which hitherto he has resisted. Such behavior consequently is nothing but a manifestation of his general attitude toward the neurosis which he created in order to avoid responsibilities and which he uses at will to prove his strength within the limits of his weakness; that is to say, he always seems to know how far he can let his neurosis go, to be able as it were to control it when faced with real disaster. If this self-induced crisis, which often initiates treatment, is taken not at its face value but merely as a necessary exaggeration on the part of the patient in order to be able to surrender, unnecessary difficulties can be avoided—difficulties which might otherwise repeat themselves in the course of the treatment.

But even when this initial resistance is disposed of therapeutically, there comes a phase during treatment when the patient feels improved and is—again wilfully—testing the validity of the cure by producing some of his old or even new symptoms. He may do this to defeat the therapeutist, as a proof that it was not the therapeutist who helped him; he may also do it in order to prove to himself that he has the power to arrest his symptoms as well as to reproduce them. Here again, as in the initial situation, one meets with the fundamental conflict of dependence-independence, the patient being desirous of showing that he can help himself and that he does not need from the other the help which he will not accept.

The third and most serious resistance of this order emerges in the end-situation, when the question in the patient's mind is not so much whether he is cured or is still sick but whether he can accept the cure proffered by the other. Especially in cases in which a rather quick result is achieved by a therapeutic handling of the fundamental resistances, it becomes obvious that it is the patient's pride which stands in the way of his acceptance. How, he asks himself, can such a complicated and well constructed neurosis of long duration be removed in such a short time by somebody else? He seems to feel that it cannot be done, and to prove it he usually becomes worse when the end of even the most successful treatment approaches. He evidently does so for another reason also, namely, to prolong his dependence and the fight against it which has replaced his neurotic struggle.

If one sums up the therapeutic experience derived from the insight into the workings of those fundamental resistances, one obtains a first glimpse into the human significance of neurosis as a general resistance to coercion, which this type of person feels exercised on him by nature herself. The whole attitude of the neurotic person toward life betrays a tendency to control external coercion inflicted on him not only by his fellow men but by nature herself. All neurotic reactions can thus be reduced to one big NO which men hurl at life. One must not forget at this point, however, that all human civilization springs from a similar spirit to conquer nature; one knows only too well that not a few of the pioneers in spiritual or material conquest have been rather close to neurosis. Yet the neurotic type of person starts by saying no to life itself, and furthermore he manifests his rebellion against the laws of nature, or practically against his own being. It is of therapeutic interest in this connection that the neurotic patient extends this wilful control, which is far from being autonomous, to the sought-for therapeutic process, which he soon feels and reacts against as a coercion. Furthermore, he extends that same attitude even to certain medications which are supposed to be

remedies for his ills. I have seen innumerable cases of nervous indigestion, insomnia and the like in which the patient used the medicine as a wilful means of controlling even his bodily functions. No relief from addiction to the use of drugs or medicines or other bad habits, including neurosis, can be achieved without considering this, without therapeutically changing this fundamental attitude of a type of person who constantly tries to dominate nature within himself instead of without. In man's use of creative imagination instead of negativistic will in order to change the world according to his own ideas lies the essential difference between success and failure.

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

May 23, 1935

C. A. McDONALD, M.D., *Presiding*

THE ELECTRO-ENCEPHALOGRAM IN EPILEPSY AND THE EFFECT OF ALTERATIONS IN BLOOD GASES ON CORTICAL ACTION POTENTIALS. DR. FREDERIC A. GIBBS.

This paper is based on two papers which have been published (Lennox, W. G.; Gibbs, F. A., and Gibbs, E. L.: Relationship of Unconsciousness to Cerebral Blood Flow and to Anoxemia, Arch. Neurol. & Psychiat. **34**:1001 [Nov.] 1935. Gibbs, F. A.; Davis, H., and Lennox, W. G.: ibid. **34**:1113 [Dec.] 1935).

DISCUSSION

DR. J. LOMAN: Dr. Gibbs has worked with my associates and me at the Boston State Hospital. Although we have had no experience with the electro-encephalographic method which he describes, our work on blood pressure and blood flow during postural alterations yielded results corresponding with his.

DR. T. J. PUTNAM: Neurologists and psychiatrists have searched for years to find some method of recording objectively the activities of the cerebral cortex, and it appears that Dr. Gibbs' work may prove a fulfilment of that wish. The abstract interest of the procedure is obvious, but it seems to me that it may have an important clinical aspect also and that the amplifier will follow the thermometer. the blood pressure apparatus and determinations of blood chemistry from the physiologic laboratory into the clinic. It would be of inestimable value if this method should prove capable of giving definite information as to the presence and location of abnormal discharges from the cortex, and I believe that this is well within the bounds of possibility.

DR. F. A. GIBBS: I hope that the complexity of the instrument used for recording the electrical activity of the cortex will not be given too much attention. The basic technic is simple, and to a really competent electrical engineer the instrument is also simple. The real complexity lies in the brain itself; having embarked on the investigation of so complex an organ, the wise neurologist will not draw back when it becomes clear that a new and fairly elaborate technic will be of great service to him.

SOME RECENT ADVANCES IN ENCEPHALOGRAPHY. DR. THEODORE J. C. VON STORCH.

Morphologic encephalography consists of roentgenographic visualization of the ventricular subarachnoid space subsequent to the replacement of the cerebrospinal fluid therein by a medium presenting a contrasting opacity to the roentgen rays. Ascending halogen oils have been used to outline the ventricles and the subarachnoid space. The results have not been satisfactory, and the method is far from safe. It has recently been demonstrated that colloidal thorium dioxide can be used for this purpose, but this method also is not free from danger.

Pneumo-encephalography consists of roentgen visualization of the ventricular subarachnoid space subsequent to the replacement of the cerebrospinal fluid by a gas. To obtain the best results a knowledge of craniovertebral dynamics is essential. Recent investigations by Weed and Flexner, Myerson and Loman, Castex and Ontaneda, Masserman and others have permitted the formulation of a working hypothesis for encephalography. The craniovertebral box is a semirigid container. The cerebrospinal fluid is separated in this box from the cerebrovascular bed by tissues reducible to a single membrane. The cerebrovascular bed in turn is connected with the systemic vascular bed and the right auricle in such fashion as to be subject to changes of pressure induced by posture and other factors.

When a person is in the recumbent position the cerebrospinal fluid pressure is a reflection of the vascular pressure in the arterioles, capillaries, venules and small veins. When he is in the sitting position the cerebrospinal fluid pressure in the lumbar region depends on two factors, one of which is the height of the column of spinal fluid above the point of puncture, and the other, the height of the column of venous blood above the point of puncture. The normal pressure is a reflection of the greatest of these, i. e., the venous pressure. Drainage of cerebrospinal fluid occurs freely from a lumbar puncture needle, the volume of the spinal fluid, but not the height of the column, being decreased. The vascular component dilates and gradually reaches its limit of distensibility, not allowing all of the spinal fluid to escape. The pressure in the lumbar sac is then atmospheric. If equal volumes of air are allowed to replace spinal fluid, the pressure will remain fairly constant for a time and then will decrease rather rapidly. The maintenance of pressure occurs during the replacement of the intracranial fluid, and the rapid fall, during the replacement of the intraspinal fluid. Hence, the volume of intracranial fluid may be computed. After replacement the pressure within the subarachnoid space is that of the gas.

It has usually been recommended that the total volume of fluid removed be replaced by a smaller volume of air to allow for expansion of the air as it is raised to body temperature. If such were actually the case, the replacement of any volume of fluid by an equal volume of gas at room temperature would increase the normal pressure in the subarachnoid space in the lumbar region from 450 to 1,014 mm. of water. Such pressures have never been observed following encephalography. The craniovertebral container is not rigid, and a decrease of only 5 cc. in the vascular volume would equalize changes following the replacement of 100 cc. of fluid. In such a semirigid container volumetric changes cannot be considered as indexes of changes of pressure, as the elasticity of the container varies and is dependent, in part at least, on vascular tone. The introduction of larger volumes of air than has been customary greatly improves the roentgenograms without increasing the patient's reaction to the procedure.

During replacement of the cerebrospinal fluid through a single aperture, such as a lumbar puncture, the intracranial pressures must be alternately decreased and increased, depending on the volumes replacing each other. Such alternation of pressure results in alternate vasodilatation and vasoconstriction. This is, in effect, a cerebral massage and is followed by hyperemia, edema, exudate and headache.

After complete replacement of the spinal fluid by gas, the pressures in the subarachnoid space are the same all along the craniovertebral axis, whether the patient is in the erect or in the recumbent position. Thus, when the patient is in the sitting position the lumbar pressure is the same as the ventricular pressure, and when the patient lies down the pressure is not altered. After complete replacement of the cerebrospinal fluid by lumbar puncture with the patient in the sitting position it is advisable to maintain a final pressure in the subarachnoid space in the lumbar region equal to the normal pressure for that patient in the recumbent position. The patient therefore returns to bed with his previously normal intracranial pressure.

Subsequently two forces act on the intracranial pressure. Gas is absorbed and fluid is formed at an increased rate. It would appear that the absorption of

gas is more rapid than the production of fluid because the cerebrospinal fluid pressure in the lumbar region is lower than normal or at least is not increased following encephalography.

When a severe reaction occurs the patient presents the combined picture of shock and aseptic meningitis and not the picture of increased intracranial pressure. Measurement of the pressure during such reactions has confirmed this view.

Other reactions subsequent to encephalography are: an increase in the cell content for forty-eight hours, the count ranging from 200 to 7,500 cells, with an early predominance of polymorphonuclear cells and later of lymphocytes, and a decrease in the protein content and an increase in the sugar content of the lumbar fluid. The blood also reveals leukocytosis and hyperglycemia. The temperature may reach 103 F. Red blood cells found in the cerebrospinal fluid are evidence of poor technic.

In a small percentage of cases encephalography has been followed by a remission in neuroses and headaches and even in petit or grand mal seizures. The mechanism of relief is unknown .

The method of replacement varies a great deal in different clinics. In infants parasagittal puncture is more applicable to ventriculography than to encephalography. Orbital puncture has been recently recommended. A consideration of the structures in the immediate proximity of the orbit would suggest that this approach is unnecessarily hazardous. Cisternal puncture has been practiced in large numbers of cases, primarily in European or South American clinics. The proximity of a needle in the cistern to the vital medullary centers curtails manipulation of the head. Without such manipulation adequate replacement of the cerebrospinal fluid is not to be expected. Castex and Ontaneda recently advocated the use of combined cisternal and lumbar punctures. Such a method produces a minimal change in the intracranial pressure. The objection to the method lies in the dangers inherent in the use of cisternal puncture.

Because of its seeming simplicity, most neurologists use the single lumbar puncture method. The alternate withdrawal of fluid and replacement with air constitute the greatest objection to such a method. Alternate cerebrovascular dilatation and constriction occur with resultant hyperemia, edema, exudate and headache and often subarachnoid hemorrhage. Two lumbar punctures may be performed with only slightly more difficulty to the operator or to the patient. With two apertures the spinal fluid may be allowed to run out as air is introduced, thus removing all alternation of pressure.

In order to control all the factors met with in practice, an apparatus has been constructed which allows for alteration of pressure, volume, temperature, type of gas and rate of flow. The attached syringe may be used to regulate the apparatus at any time, while pressures are constantly observed in the attached manometer. The air is sterilized and saturated with warm water as it passes to the subarachnoid space. Any gas may be used at any time during replacement, and samples of fluid may be withdrawn. The use of such an apparatus has minimized the patients' reactions objectively and subjectively, has freed the operator from carrying out the replacement, allowing him to attend the patient, and has improved the roentgenographic results. This apparatus has been used at the Boston City Hospital in over 40 cases and at the Massachusetts General Hospital in more than 30. A double needle has been devised to facilitate the procedure and to eliminate the necessity of two lumbar punctures.

To obtain adequate encephalograms with a minimum of reaction on the part of the patient and maximum standardization, several rules are recommended: 1. Encephalography is contraindicated in cases in which the intracranial pressure is 200 mm. or above or in which there are cerebral aneurysms or weak-walled vascular anomalies. 2. It is indicated in all other cases in which an intracranial lesion is suspected which cannot be localized by other means. 3. A complete study of the cerebrospinal fluid from the lumbar region should precede the making of each encephalogram. 4. The use of nonvolatile narcotics, such as tri-bromethanol in amylene hydrate, amytal and pentobarbital sodium, is recommended. They are

contraindicated as anesthetics for patients who have been taking barbiturates. 5. The entire procedure from puncture to picture should be performed with the patient sitting erect. 6. The use of an automatic simultaneous replacement apparatus in conjunction with a double puncture needle is recommended. 7. During replacement, the patient's head should be slowly and continuously flexed anteriorly and posteriorly, but no other movements should be allowed. 8. All available fluid should be removed and replaced by enough air to maintain, with the patient erect, a pressure in the subarachnoid space in the lumbar region equal to the pressure previously ascertained with the patient in the recumbent position, regardless of the relative volumes necessary. If it is not desirable to remove all of the fluid, it should be replaced until the rapid fall in pressure begins—at that point, the intracranial spaces have been emptied. 9. Roentgenograms should be taken immediately after the completion of replacement. In cases in which lesions of the temporal lobe are suspected lateral views should be taken with the patient recumbent, and in cases of occipital lesions, anteroposterior views with the patient in the same position. Views made with the patient in the recumbent position should be taken after those made with the patient erect. 10. Postoperative treatment consists of the application of heat with the patient in bed and the administration of fluids and sedatives.

Interpretation of encephalograms is advancing chiefly through the impetus and excellent studies of Davidoff and Dyke on more than 2,300 encephalograms at the Neurological Institute of New York. Structures are being seen that had not been seen before, and things formerly considered to be pathologic entities are being recognized as normal structures.

In encephalograms made with the patient erect, the temporal horns rarely show and there are fluid levels in the ventricles. There is more air in the supraparietal than in the frontal or the occipital region. Occasionally air is seen in the subdural space at the vertex, often under the tentorium. Unilateral excess of air in the subarachnoid space may be due to lateral flexion of the patient's head during replacement. One is accustomed to see the following structures in anteroposterior views: the falx, the cingulate gyrus, the corpus callosum, the septum pellucidum, the pillars of the fornix, the roof of the thalamus, the choroidal bodies, the anterolateral ventricles, the third ventricle, the tentorial apex, the sylvian fissure, the island of Reil and occasionally the hippocampal bodies and the fourth ventricle. In lateral views, one sees the following structures: the fourth ventricle, the aqueduct, the third and lateral ventricles, the corpus callosum, the cingulate gyrus, the tentorium, the vermis, the anterior medullary velum, the quadrigeminal bodies, the mamillary bodies, the infundibulum, the optic nerve, the basilar arteries and the cisterna magna, cisterna pontis, cisterna interpeduncularis, cisterna chiasmatica and cisterna ambiens. The cisterna ambiens is not to be confused with the temporal horns. Occasionally one sees the calcarine, parieto-occipital, sylvian and rolandic fissures. The latter, if not seen, lies along a line between the end of the cingulate sulcus and the sella turcica. The basilar arteries were once considered evidence of basilar arachnitis. The glomus of the choroid may be confused with intraventricular tumors. It may be enlarged in a ventriculogram owing to the presence of a hematoma.

DISCUSSION

DR. ROBERT SCHWAB: My colleague and I constructed a somewhat similar machine from material around the laboratory, and I have made 37 encephalograms with it to date. The important thing is the reduction of the reaction and a slightly better filling of the ventricles. In these 37 cases, cell counts have been made at the beginning of the procedure, at the end of the injection of air and at the end of twenty-four hours. Between 5 and 12 cells appeared at the end of the procedure, as compared with from 30 to 50 with the old syringe method. The aseptic meningitis twenty-four hours later is about the same as with the old method, i. e., from 500 to 1,500 cells. Most of our patients were comparatively comfortable after the third day and were usually up on the fifth day. We agree with Dyke, of the

Neurological Institute of New York, that the important thing in the technic is carrying out the whole procedure in the x-ray room. After 60 cc. of air has been injected one can take a trial picture, develop it in an adjacent dark room and, if the filling is adequate, withdraw the needles and take the rest of the pictures. If the filling is not adequate, more air can be introduced. Since the procedure is a closed one, the operator need not keep sterile and can assist the roentgenologist during the making of the trial plates. I think that Dr. von Storch deserves much credit for eliminating some of the suffering and failures in connection with this work and for simplifying the procedure so that it can be done in cases of epilepsy and in some cases of neoplasm.

DR. T. J. C. VON STORCH: I have looked over Dr. Schwab's data, and they agree essentially with mine. I have not as yet used the method of taking a trial picture after only a small amount of air has been introduced but intend to do so.

A TECHNIC OF INJECTION INTO THE GASSERIAN GANGLION UNDER ROENTGENOGRAPHIC CONTROL. DR. TRACY J. PUTNAM and DR. AUBREY O. HAMPTON (by invitation).

This article was published in full in the January 1936 issue of the ARCHIVES, page 92.

THE USE OF PHENYLISOPROPYLAMINE FOR THE TREATMENT OF NARCOLEPSY. DR. MYRON PRINZMETAL and DR. WILFRED BLOOMBERG.

This paper will be published in full elsewhere.

DISCUSSION

DR. MYRON PRINZMETAL: I think that it is clear that there is nothing unique about the action of phenylisopropylamine in cases of narcolepsy. Ephedrine is useful in many cases. Phenylisopropylamine is also useful, as are probably several other sympathomimetic compounds of the same series. We found merely that phenylisopropylamine was more effective than ephedrine and other closely related compounds.

Regarding the action of these compounds on the nervous system, it seems that there are two separate effects. First, there is the stimulating action on the peripheral nervous system, which raises the blood pressure, dilates the bronchi, etc., and then there is the stimulating action on the central nervous system, which is useful in cases of narcolepsy. It seems probable that the effect on the central nervous system is one of direct stimulation rather than of vasomotor changes in the brain. I think that this is so because I recently studied a case of postural hypotension in which there were dizziness and faintness associated with a fall in the blood pressure when the patient was in the upright position. Phenylisopropylamine, which has a mild stimulating effect on the peripheral nervous system, had no effect on this patient's blood pressure but completely abolished the symptoms. Hydroxyphenylpropylamine, another sympathomimetic compound which has a profound stimulating action on the peripheral nervous system with very slight effect on the central nervous system, prevented the fall in blood pressure when the patient was in the upright position but did not prevent the dizziness and faintness.

Whenever a new physiologically active compound is shown to be useful in certain conditions it is frequently uncritically used in other related conditions. I feel that the greatest caution should be taken when a new compound is used for the first time. Dr. Philip Solomon and I have been studying the effect of phenylisopropylamine in other neurologic conditions, especially certain forms of asthenia; although in postencephalitis Parkinson's disease our results are encouraging, we feel that it will require much intensive study and experience before we can be sure of its usefulness in these other related states. I have waited two years before making this report on narcolepsy.

Book Reviews

Handbuch der Neurologie. Edited by O. Bumke and O. Foerster. Volume 1. **General Neurology: I. Anatomy.** Price, 225 marks. Pp. 1,152, with 585 illustrations. Berlin: Julius Springer, 1935.

This is a large volume, the first in the new *Handbuch* edited by Bumke and Foerster. It is concerned entirely with the anatomy of the nervous system. The first chapter is on the ontogenesis of the nervous system and the sympathetic system and the phylogenesis of the nervous system. It is by M. Rose. Bielschowsky contributes a long article on the general histology and histopathology of the nervous system. It is extremely well done and is similar to other articles of this type which he has contributed. A short and inadequate chapter on the anatomy of the peripheral nerves is contributed by Alice Rosenstein. The article on the spinal cord, medulla and pons by Pollak is good, but less space is given to the medulla than seems desirable. Gagel's article on the cerebellum borrows heavily from Jakob and is much less complete than the discussion by the latter. There is a satisfactory article by Spatz on the midbrain. One of the best chapters in the book is that of Rose on the anatomy of the end-brain and the cyto-architecture of the cortex. It is both complete and sound. The article by Freedom on the angio-architecture is sketchy, as is the article on the glial architecture of the brain by Schroeder. Greving has a good article on the histology of the vegetative nervous system. One of the outstanding features of the volume is an article by Ramón y Cajal on the neuron theory, which is a fine defense of this theory as well as a masterly review by the master of all histologists. Finally, Bocke contributes an article on nerve regeneration.

Like all German handbooks, this volume suffers from too much repetition. All the handbooks seem to cover the same anatomic ground in almost the same way. The present volume differs from the others in the masterly article by Ramón y Cajal, the excellent chapter on cyto-architecture by Rose and the up-to-date chapter on the histology of the vegetative nervous system by Greving. Otherwise, there is little to distinguish the volume from similar volumes in other handbooks.

Handbuch der Neurologie. Edited by O. Bumke and O. Foerster. Volume 9. **Special Neurology—Muscles and Peripheral Nerves.** Price, 49.60 marks. Pp. 259, with 57 illustrations. Berlin: Julius Springer, 1935.

This volume is concerned with myalgia, neuritis, neuralgias and tumors of the peripheral nerves. There is a short article on myalgia and myositis by Moser. Traumatic diseases of the peripheral nerves and plexus and neuritis are treated by Wexberg. This section on neuritis is well presented. The classification of the neuritides is essentially the same as that employed in most textbooks. A useful section on local neuritis includes traumatic neuritis caused by the effects of stretching, injection neuritis and refrigeration neuritis. There is a useful summary concerning the neuritis due to unusual stretch, with an account of the various nerves injured and the circumstances of their injury. The other forms of neuritis are adequately treated, particularly so-called sciatica.

The histopathology of neuritis is described by Villaverde. This section is extremely well done. The mononeuritides and polyneuritides are well covered. Silver staining naturally occupies a prominent part of the section, possibly somewhat to the detriment of other histologic methods.

The section on neuralgias is by Wexberg. Trigeminal neuralgia naturally occupies the largest portion of this section. The section on treatment deals only cursorily with the radical operation for tic douloureux and discusses many methods of doubtful value. This seems hardly just to the only absolute means of relieving

trigeminal neuralgia. No mention is made of Dandy's operation on the posterior cranial fossa for this disease. Only a short section is devoted to glossopharyngeal neuralgia.

Gagel has a good article on tumors of the peripheral nerves.

The volume is well planned and on the whole maintains a high standard. It can be recommended highly.

Benign Encapsulated Tumors in the Lateral Ventricles of the Brain. By Walter E. Dandy. Pp. 189, with 83 figures and 2 tables. Baltimore: Williams & Wilkins Company, 1934.

This book is a companion to the monograph published by Dandy in 1933, "Benign Tumors in the Third Ventricle of the Brain; Diagnosis and Treatment," Baltimore, Williams & Wilkins Company, and details personal experiences with fifteen benign encapsulated tumors of the lateral ventricle, together with an account of twenty-five other tumors reported in the literature. The fact that only one death has occurred in the last eleven cases is attributed to the ability of the author in localization and extirpation, since, as he himself states, "It need hardly be added that a fatality is an almost necessary sequel to any misplaced cranial exposure." Dandy has been unable to reconstruct any clinical syndrome by which the diagnosis can be made and relies entirely on ventriculography. The chapters dealing with ventriculography and with the surgical aspects of the cases are direct and to the point, dogmatic at times and well written. In the rest of the book rather numerous errors have been overlooked, and it is thought that it is a serious omission to give no consideration to the small and sometimes large localized tumors that arise from the ventricular wall in tuberous sclerosis. Indeed, the whole section on pathology is exceptionally weak, since, according to present-day standards, such designations as "ependymal fibroma or glioma" are no longer considered adequate. The cavalier treatment accorded by the author to pathology and pathologists might be interpreted as an unconscious realization of this defect.

The tumors that develop within the lateral ventricles are apparently of different classes, but the colloid cyst so frequently encountered in the third ventricle does not occur in this series. Instances of tumors and cysts that develop from the choroid plexus and tumors that develop probably from the ependyma and extend into the ventricle make up the majority of the cases. An angioma is listed, as well as one excellent example (case 9) of the type of tumor that occurs frequently in tuberous sclerosis, made up of large polyhedral undifferentiated cells with large fascicular nuclei and definite nucleoli. The illustrations of the patients, the tumors and the ventriculograms deserve high praise. All in all, the contribution compares well with other neurosurgical monographs published in this country.